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TABULATIONS OF AMBIENT OZONE DATA OBTAINED BY GASP AIRLINERS; M--ETC (1)
SEP 80 6 D NASTROM; J D HOLDEMAN DOT-FA78WAI-893
UNCLASSIFIED NASA-TN-81588 FAA/EE-80-43 NL

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Tabulations of Ambient Ozone Data Obtained by GASP Airlines; March 1975 to December 1977

September 1980

Gregory D. Nastrom and
James D. Holdeman

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PREFACE

This report contains part of the data obtained by the Global Air Sampling Program (GASP) since the publication of Federal Aviation Administration (FAA) Report Number FAA-EQ-78-03, "Guidelines for Flight Planning During Periods of High Ozone Occurrence."

The FAA has recently published Advisory Circular Number AC-120-38, "Transport Category Airplanes Cabin Ozone Concentrations." (Copies of this advisory circular may be obtained free of charge from the U.S. Department of Transportation; Publications Section M443.1; Washington, D.C. 20590.) In this document, examples were presented of acceptable (but not the only) means for an air carrier to demonstrate compliance with the maximum permissible cabin ozone concentrations established by Section 121.578 of the Federal Aviation Regulations (FAR). In paragraph 6 and Appendix 2 of this advisory circular, it is stated that any ozone data set used to show compliance must have, as a minimum, a resolution on a monthly basis of 2000 feet in altitude and 5 degrees in latitude.

Even though the GASP data in this report are not tabulated to conform to these resolution requirements, we would like to disseminate them at this time as information to the scientific community and other interested groups. Use of these data, as tabulated, to show compliance with Section 121.578 of the FAR is neither recommended nor acceptable.

We plan to publish all of the GASP data at a later date with the required resolution (monthly, 2000 feet in altitude, 5 degrees in latitude) and at that time will state the FAA policy as to their acceptability for use in satisfying the requirements of Section 121.578 of the FAR.

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SUMMARY

Tabulations are given of GASP ambient ozone mean, standard deviation, median, 84th percentile, and 98th percentile values, by season, flight level, and geographical region. These tables supersede those in appendix B of "Guidelines for Flight Planning During Periods of High Ozone Occurrence" (FAA-EQ-78-03), and include empirical probability data which are not available in any previous climatological ozone tabulations. Selected probability variations are highlighted to illustrate the types of curves which might be appropriate in specific analyses of the tabulated data, and an example-case calculation is presented to illustrate the use of the tabulated data in estimating the frequency of commercial airline flights encountering high cabin ozone levels.

INTRODUCTION

Since March 1975 the NASA Global Atmospheric Sampling Program (GASP) has been obtaining, archiving, and analyzing atmospheric trace-constituents data in the upper troposphere and lower stratosphere using fully automated sampling systems on several Boeing 747 airplanes in routine commercial service (ref. 1). GASP systems have been operated on a United Airlines B747, two Pan American World Airways B747's, and a Qantas Airways of Australia B747. Data from the United airliner were over the contiguous United States and between the U.S. West Coast and Hawaii. Global coverage was provided by the Pan Am and Qantas airliners on routes between U.S.A. and Europe, U.S.A. and South America, U.S.A. and Japan, U.S.A. and Australia, Australia and Africa, and Australia and Europe.

Used in compiling the tabulations presented herein were 64 620 ambient ozone observations from over 2000 flights of these airliners between March 11, 1975, and January 5, 1978. These tables supersede those given in appendix B of "Guidelines for Flight Planning During Periods of High Ozone Occurrence" (ref. 2). It is anticipated that these tables will again be updated when the remainder of the GASP data (January 1978 - June 1979) are processed into a format suitable for analysis.

INSTRUMENTATION

Ozone was measured on all aircraft by commercially available ultraviolet absorption photometers modified and repackaged to operate in the airborne environment. Readings are continuous, updating every 20 seconds, with data recorded nominally eight times per hour. The instrument range is from 0.003 to 20 ppmv (parts per million by volume). Operational procedures, set up to insure the integrity of the data, included in-flight instrument health

checks, instrument calibration techniques, measurement of ozone loss in the GASP air sample inlet line and pressurization system (ref. 3), and periodic instrument maintenance.

All flight instruments were calibrated before installation in the aircraft and periodically thereafter using a secondary transfer standard. This standard is a laboratory-type ultraviolet photometer which was initially calibrated using a 1 percent neutral buffered potassium iodide (KI) method. Later in the GASP program, the standard was calibrated at the NASA Jet Propulsion Laboratory (JPL). This calibration is traceable to the JPL 5-meter UV photometer described in reference 4. The KI calibration was found to be 9 percent higher than the UV photometer calibration. Thus, all published GASP ozone data are 9 percent higher than the JPL calibrations. This is a systematic difference and can be easily corrected if the KI method is determined to be incorrect and another method, such as the UV photometer, is adopted as the standard.

The random error of the GASP ozone measuring system was found to be less than 4 percent of reading or 0.003 ppmv, whichever is greater. A complete description of the ozone measurement system is given in reference 3.

PRESENTATION OF DATA

Availability

All GASP data are available to the public on magnetic computer tape from the National Climatic Center, Federal Building, Asheville, North Carolina 28801. The data tabulated here are from GASP tapes VL0001 to VL0014. These tapes include all data obtained by GASP-equipped aircraft from March 11, 1975, to January 5, 1976. Flight routes and dates, instrumentation, data processing procedures, data tape specifications, and selected analysis are reported in references 5 to 14.

Explanation of Data Tables

In this report ozone amounts are expressed as a volumetric mixing ratio, parts per million by volume (ppmv). Since ozone levels in the literature may be expressed in any of several commonly used units, the interrelationship among these is given in appendix A. Note that several of these relations require that temperature and/or pressure be known or assumed and that the conversion of averaged values will be an approximation because of the nonlinearity of the conversion.

The GASP data in tables I to XII are summarized by season for the 5000-ft altitude increments in geographical regions of 10° latitude by 45° longitude shown in figure 1. These flight levels, 285 to 335, 335 to 385, and 385 to 435 (28 500 to 33 500, 33 500 to 38 500, and 38 500 to 43 500 ft), may be considered representative of low, medium, and high altitude cruise conditions for B747 aircraft, and contain, respectively, about 20, 45, and 30 percent of all GASP observations. The geographical regions were selected so that regions, or combinations of adjacent regions, coincide with major flight routes as nearly as possible (e.g., contiguous

U.S. = 30° to 50° N, 75° to 120° W; and U.S.A. to Europe = 40° to 60° N, 15° E to 75° W). For each region, the tabulation includes mean, standard deviation, median (50th percentile), 84th percentile, and 98th percentile ozone amounts, in addition to the number of observations. If needed, more detailed altitude resolution is provided by the tabulations at odd-thousand-foot altitudes in appendix B, but note that, because the number of observations in the tabulated geographical regions is smaller here than in tables I to XII, the statistical confidence level is less in some intervals.

It is well known that ozone levels are low in the troposphere and increase with altitude above the tropopause. This is apparent in the appendix C tables which give the ozone mean, standard deviation, median, 84th percentile, and 98th percentile levels for all GASP observations in 5000-ft intervals with respect to the tropopause^{1,2}.

An example of the way these tabulations can be used to estimate the frequency of commercial airline flights encountering high cabin ozone is given in appendix D.

Selected Graphical Presentations

It is well known that ozone levels increase with latitude and altitude, that they are maximum in the spring, and that the probability of encountering high ozone levels follows the same trends (e.g. ref. 17). These variations are quantified in the tables herein, with selected empirical probability variations highlighted in figures 2 to 5. These figures are intended as examples of the types of curves which can readily be plotted from, and which might be appropriate in specific analyses of, the tabulated data.

¹The tropopause pressure for each GASP observation was obtained by time-and-space interpolation from National Meteorological Center (NMC) archived data fields. Except for winter and spring 1976, these fields were determined by the Flattery global analysis method (ref. 15). The only tropopause pressure data available to GASP for winter and spring 1976 were determined by the Gustafson method (ref. 16), which, as reported in refs. 8 to 11, appears to define a consistently lower tropopause than does the Flattery method. Based on (unpublished) analyses of GASP data from July 1976 through December 1977 for which tropopause pressure values from both schemes were available, we have reduced all NMC tropopause pressures for winter and spring 1976 by 50 hPa (mbar).

²Care in using a consistent tropopause definition is critical. For example, in the appendix C tables which are with respect to the Flattery tropopause, 25 percent of all observations were in the stratosphere. However, if the data for 0 to 5000 ft below the Flattery tropopause are included in the stratosphere, as they would be in analyses with respect to the Gustafson tropopause, then one would conclude that 50 percent of all observations were in the stratosphere.

In figure 2 the variation of the median (50th percentile) ozone mixing ratio with latitude is shown for low, medium, and high cruise altitudes in the spring (part (a)), and for each season at flight levels 335 to 385 (part(b)). Note that for $|LAT| > 20^\circ$, variations with latitude, season, and flight level are all significant.

In figure 3, four-point cumulative frequency distributions (cfd's) have been plotted from the tabulated data for selected latitudes at flight levels 335 to 385 in the spring. These curves show the fraction of observations (on the ordinate) in which the ozone level equalled or exceeded any given ozone level (on the abscissa). For example, at 40° to 50° N latitude, the probability of encountering ambient ozone greater than 0.3 ppmv would be 40 percent.

Figure 4 shows the zonal latitude-flight level cross section of the 84th percentile ozone values for spring. The constant mixing ratio contours define regions where the probability is greater than 16 percent that the ozone will exceed the contour value on any independent observation; that is, the probability of encountering ozone above, say 0.2 ppmv, is greater than 16 percent in all regions where the 84th percentile value is greater than 0.2 ppmv. In figure 5, the same data used in figure 3 are cross plotted to show the vertical distributions of the 84th percentile values at selected latitudes.

CONCLUDING REMARKS

Tabulations are given of GASP ambient ozone mean, standard deviation, median, 84th percentile, and 98th percentile values, by season, flight level, and geographical region. These tables supercede those in appendix B of "Guidelines for Flight Planning During Periods of High Ozone Occurrence" (FAA-EQ-78-03), and include empirical probability data which are not available in any previous climatological ozone tabulations. Selected probability variations are highlighted herein to illustrate the types of curves which can readily be plotted from, and which might be appropriate in specific analyses of, the tabulated data. Also an example-case calculation is presented in an appendix to illustrate how these tables might be used to estimate the frequency of commercial airline flights encountering high cabin ozone levels.

TABLE I. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.090 .066 80 .069 .121 .287				
30	.069 .041 171 .061 .105 .182		.047 .034 22 .040 .069 .155	.040 .002 2 .038 .041 .041	
20	.073 .039 65 .064 .111 .167	.051 .022 122 .050 .062 .130	.017 .023 24 .011 .014 .114		
10		.044 .018 138 .042 .066 .078	.027 .019 11 .020 .035 .076		
0		.039 .019 74 .033 .060 .086	.023 .011 11 .025 .033 .041	.022 .007 16 .019 .029 .034	
10		.021 .010 24 .021 .030 .039	.022 .009 32 .021 .030 .040	.023 .003 18 .024 .025 .032	
20		.032 .014 16 .034 .045 .057	.035 .017 43 .037 .046 .078	.022 .016 60 .019 .037 .062	
30	.053 .023 72 .046 .076 .109	.070 .023 33 .067 .091 .106	.055 .025 55 .051 .025 .108	.057 .036 87 .050 .095 .104	
40		.072 .021 21 .077 .094 .104	.079 .052 85 .074 .095 .275	.071 .036 105 .072 .100 .183	
50				.159 1	
60					
70					
80					
90S					

DATA FOR WINTER AT FL 285 TO 335

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.229 .047 9 .223 .283 .288	.224 .097 45 .233 .299 .441	.167 .048 19 .163 .222 .251	.213 .086 73 .214 .269 .441		70
.232 .062 14 .218 .300 .324	.241 .046 28 .251 .287 .296	.151 .123 44 .119 .303 .387	.130 .103 87 .084 .233 .339	.161 .108 173 .177 .276 .381		60
.039 .024 25 .040 .066 .083	.095 .077 37 .051 .164 .249	.061 .053 51 .034 .148 .170	.111 .096 52 .063 .225 .322	.084 .074 245 .056 .155 .287		50
.061 .056 148 .042 .093 .234	.062 .043 58 .055 .069 .176			.064 .048 401 .050 .093 .203		40
.039 .028 144 .030 .061 .114				.046 .032 355 .045 .068 .145		30
.025 .010 35 .025 .034 .042				.040 .019 124 .037 .063 .070		20
.023 .007 3 .022 .032 .032				.034 .018 104 .031 .051 .080		10
				.022 .008 74 .023 .030 .040		0
.033 .016 13 .033 .056 .057				.029 .017 132 .024 .045 .062		10
				.056 .029 247 .052 .089 .108		20
				.075 .042 211 .074 .094 .231		30
				.159 1		40
						50
						60
						70
						80
						90S

TABLE II. - GASP AMBIENT OZONE

Code: Mean St. Dev. N
507 847 987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.032	1
50				.282 .220 73 .294 .524 .755	
40	.176 .116 74 .125 .310 .452		.464 .261 8 .450 .728 .801	.345 .212 58 .367 .581 .699	
30	.119 .094 116 .079 .205 .359		.182 .117 27 .205 .311 .323	.229 .191 56 .122 .497 .600	
20	.071 .022 19 .075 .082 .107	.052 .023 72 .049 .076 .102	.066 .018 4 .062 .078 .095		
10	.065 1	.040 .018 83 .038 .056 .080	.020 .048 30 .005 .026 .063	.020 .021 49 .010 .039 .059	
0		.039 .021 58 .034 .063 .081	.020 .010 13 .020 .028 .042	.027 .010 75 .027 .037 .051	
10		.028 .012 34 .028 .035 .063	.023 .016 56 .023 .042 .057	.023 .010 106 .024 .032 .045	
20		.041 .013 31 .042 .052 .064	.040 .018 75 .039 .056 .080	.031 .016 96 .024 .048 .066	
30	.034 .005 8 .035 .038 .040	.033 .009 50 .031 .042 .051	.056 .023 132 .052 .082 .103	.054 .032 116 .018 .088 .122	
40		.063 .025 11 .054 .091 .093	.091 .048 168 .080 .129 .239	.102 .073 64 .086 .125 .346	
50				.102 .030 9 .111 .125 .142	
60					
70					
80					
90S					

DATA FOR WINTER AT FL 33 TO 385

[illegible]

TABLE III. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.354 .188 15 .230 .580 .659	
50				.400 .354 125 .193 .821 1.198	
40			.304 .261 48 .166 .666 .900	.299 .289 85 .155 .709 .936	
30			.130 .179 43 .043 .198 .626	.370 .191 41 .342 .489 .753	
20			.015 .003 17 .015 .018 .021		
10		.009 .004 6 .007 .011 .017	.009 .005 51 .008 .014 .021		
0		.008 .004 5 .009 .010 .013	.011 .004 24 .011 .015 .018	.023 .007 9 .025 .032 .036	
10		.035 .004 2 .030 .039 .039	.028 .013 17 .029 .039 .046	.030 .011 73 .027 .043 .055	
20			.014 .007 5 .010 .022 .024	.035 .016 90 .029 .054 .068	
30				.090 .052 58 .094 .138 .191	
40			.090 .032 43 .076 .122 .164	.186 .088 122 .161 .274 .388	
50					
60					
70					
80					
90S					

DATA FOR WINTER AT FL 385 TO 435

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
.404 .154 .45 .374 .579 .656				.391 .168 .60 .367 .579 .656		60
.397 .140 .49 .442 .566 .642	.408 .160 .36 .435 .512 .805	.449 1	.369 .048 .6 .385 .401 .429	.400 .287 .217 .401 .639 1.261		50
.112 .054 .37 .102 .169 .279	.251 .192 .365 .193 .401 .852	.151 .208 .52 .039 .457 .626	.356 .154 .28 .351 .526 .551	.250 .216 .615 .169 .458 .866		40
.191 .148 .299 .153 .338 .626	.161 .130 .317 .126 .249 .626			.184 .154 .700 .141 .291 .645		30
.099 .054 .295 .084 .165 .252				.095 .061 .312 .081 .156 .252		20
.044 .025 .140 .034 .071 .113				.034 .027 .197 .027 .059 .109		10
.029 .009 .147 .028 .037 .051				.026 .011 .185 .026 .036 .051		0
.031 .009 .70 .029 .038 .053				.030 .011 .162 .029 .042 .053		10
.041 .023 .102 .032 .065 .096				.037 .020 .197 .031 .057 .090		20
				.090 .052 .58 .094 .138 .191		30
				.162 .088 .163 .135 .258 .378		40
						50
						60
						70
						80
						90S

TABLE IV. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
507	84	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.532 .117 14 .551 .633 .683	
40	.112 .090 56 .064 .213 .345		.073 .010 3 .071 .086 .086	.148 .143 72 .041 .270 .613	
30	.097 .083 232 .063 .154 .360		.105 .104 61 .073 .139 .560	.180 .130 30 .131 .260 .462	
20	.046 .009 33 .043 .052 .065	.061 .023 144 .055 .076 .125	.053 .028 47 .051 .090 .100	.054 .018 42 .054 .058 .106	
10		.039 .016 75 .041 .053 .066	.036 .018 77 .039 .053 .067	.037 .021 81 .031 .053 .087	
0		.028 .011 67 .025 .041 .048	.028 .014 16 .023 .034 .061	.017 .006 63 .017 .021 .029	
10		.031 .008 23 .034 .038 .050	.026 .007 49 .025 .033 .032	.014 .007 64 .014 .021 .025	
20		.035 .010 24 .032 .043 .056	.035 .008 39 .033 .046 .049	.021 .008 86 .022 .027 .033	
30	.034 .017 40 .037 .054 .059	.042 .008 32 .044 .050 .055	.035 .008 84 .035 .044 .061	.032 .015 131 .030 .046 .063	
40		.045 .008 10 .042 .045 .069	.036 .021 46 .031 .045 .072	.049 .043 155 .034 .055 .191	
50				.034 .009 11 .030 .046 .048	
60					
70					
80					
90S					

DATA FOR SPRING AT FL 285 TO 335

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
			.328 .033 3 .371 .371 .371	.328 .033 3 .321 .371 .371		70
.199 1	.331 .162 23 .312 .430 .613	.322 .139 18 .300 .566 .647	.169 .075 24 .145 .243 .259	.284 .157 66 .251 .439 .613		60
.249 .125 7 .294 .433 .459	.333 .166 38 .395 .484 .567	.154 .140 104 .089 .277 .566	.130 .114 263 .078 .235 .462	.179 .155 426 .285 .252 .575		50
.187 .164 80 .092 .410 .524	.142 .121 208 .092 .253 .470	.166 .147 339 .092 .368 .521	.088 .082 50 .063 .106 .368	.152 .137 809 .078 .297 .519		40
.089 .082 405 .071 .102 .386	.187 .182 89 .088 .396 .632	.089 .030 16 .073 .096 .154		.106 .106 633 .073 .154 .493		30
.072 .054 391 .067 .095 .154	.063 .040 92 .049 .103 .146	.078 .057 16 .053 .090 .266		.066 .044 765 .057 .092 .146		20
.039 .022 61 .042 .057 .077	.020 .011 28 .019 .025 .049	.032 .012 37 .029 .042 .053		.036 .019 334 .034 .053 .079		10
.018 .005 2 .013 .023 .023	.013 .003 4 .014 .014 .017	.031 .019 23 .029 .037 .097		.024 .013 175 .021 .035 .059		0
		.029 .005 12 .031 .032 .037		.022 .010 142 .021 .033 .038		10
		.026 .007 21 .028 .033 .040		.027 .010 170 .027 .036 .049		20
		.015 .007 6 .013 .022 .027		.034 .014 293 .035 .049 .062		30
				.044 .036 261 .033 .051 .168		40
				.034 .009 11 .030 .046 .048		50
						60
						70
						80
						90S

TABLE V. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.549 .228 66 .596 .735 .911	
40	.279 .213 120 .292 .495 .682		.520 .182 13 .618 .665 .690	.354 .269 142 .280 .703 .848	
30	.167 .138 147 .124 .354 .492	.190 1	.166 .143 72 .097 .246 .596	.159 .167 64 .094 .248 .705	
20	.121 .020 7 .130 .132 .145	.077 .042 164 .069 .103 .234	.070 .028 34 .058 .100 .121	.064 .031 200 .058 .090 .144	
10		.031 .020 64 .030 .049 .086	.035 .019 110 .032 .056 .072	.054 .030 156 .049 .084 .129	
0		.025 .011 37 .019 .039 .044	.025 .008 14 .022 .034 .039	.016 .008 67 .014 .021 .045	
10		.026 .006 33 .026 .032 .037	.024 .008 42 .023 .032 .037	.021 .013 85 .017 .029 .062	
20		.029 .008 24 .027 .033 .048	.031 .011 41 .029 .043 .052	.026 .018 74 .021 .044 .078	
30		.064 .039 25 .050 .108 .153	.035 .011 46 .032 .047 .056	.029 .018 123 .023 .047 .077	
40		.057 .015 10 .057 .065 .082	.052 .033 78 .042 .066 .149	.053 .023 50 .050 .077 .097	
50					
60					
70					
80					
90S					

DATA FOR SPRING AT FL 335 TO 385

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.436 .072 9 .416 .520 .557	.528 .084 14 .487 .641 .695	.451 .015 3 .452 .469 .464	.488 .087 26 .469 .560 .461		70
.442 .226 35 .430 .664 .778	.601 .125 70 .419 .715 .841	.552 .098 62 .563 .637 .707	.422 .184 13 .533 .570 .598	.540 .162 183 .574 .667 .822		60
.498 .238 103 .547 .731 .871	.300 .165 99 .300 .497 .633	.305 .191 261 .264 .551 .727	.239 .176 445 .178 .451 .653	.311 .217 974 .253 .577 .814		50
.307 .227 228 .225 .593 .748	.256 .204 789 .168 .486 .759	.252 .179 269 .208 .428 .476	.291 .213 131 .265 .455 .703	.276 .215 1692 .202 .523 .757		40
.124 .114 1474 .089 .176 .526	.204 .179 579 .123 .406 .686	.134 .087 25 .107 .210 .409		.149 .140 2364 .097 .240 .616		30
.090 .049 1339 .084 .124 .222	.042 .043 48 .030 .066 .125	.047 .021 15 .041 .056 .119		.084 .048 1607 .079 .118 .213		20
.034 .026 80 .026 .050 .111	.037 .024 186 .037 .060 .094	.033 .016 58 .030 .048 .068		.039 .025 663 .036 .060 .109		10
.029 .011 23 .027 .036 .059	.015 .012 12 .010 .030 .036	.019 .013 98 .018 .031 .044		.020 .012 253 .018 .032 .045		0
		.022 .018 128 .016 .037 .061		.023 .015 285 .020 .034 .061		10
		.024 .012 113 .025 .038 .045		.026 .014 252 .024 .041 .067		20
		.029 .019 10 .027 .041 .064		.035 .023 204 .028 .050 .108		30
				.053 .029 132 .048 .076 .142		40
						50
						60
						70
						80
						90S

TABLE VI. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.613 .136 12 .609 .743 .832	
50				.676 .196 113 .669 .859 1.091	
40	.206 .115 36 .197 .321 .410		.547 .181 40 .554 .750 .826	.476 .329 124 .430 .847 1.058	
30	.327 .269 38 .231 .741 .838		.261 .187 38 .264 .413 .729	.072 .006 4 .049 .074 .080	
20	.200 .073 8 .177 .262 .325	.109 .023 4 .095 .100 .148	.045 .027 26 .035 .078 .161	.084 .014 7 .090 .093 .097	
10		.087 .025 8 .079 .110 .124	.031 .010 24 .029 .038 .056	.036 .009 8 .037 .043 .048	
0				.036 .017 9 .038 .054 .062	
10				.031 .013 45 .032 .041 .062	
20				.038 .016 51 .035 .053 .070	
30				.066 .079 55 .034 .085 .309	
40			.060 .008 7 .058 .067 .076	.091 .036 74 .087 .124 .189	
50					
60					
70					
80					
90S					

DATA FOR SPRING AT FL 385 TO 435

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.546 .153 39 .503 .767 .835					.551 .152 5. .525 .767 .835	70
.506 .730 69 .475 .725 .979	.426 .201 39 .493 .748 .974	.467 .140 210 .441 .569 .845	.541 .195 145 .507 .695 1.095	.542 .196 576 .505 .732 1.054		60
.433 .205 153 .445 .454 .234	.749 .227 918 .722 .407 .922	.347 .191 333 .358 .553 .704	.511 .221 92 .458 .726 .993	.386 .222 1694 .305 .622 .931		50
.273 .225 350 .193 .495 .421	.284 .208 751 .712 .504 .831	.155 .048 9 .089 .133 .210		.279 .215 1194 .216 .503 .830		40
.134 .276 143 .119 .216 .230	.060 .039 84 .255 .109 .125	.033 .021 13 .026 .039 .053		.119 .078 5.0 .103 .194 .215		30
.037 .020 59 .033 .051 .098	.040 .030 37 .032 .064 .107	.027 .003 4 .026 .026 .034		.039 .025 14. .035 .052 .106		20
.032 .014 61 .034 .043 .062		.017 .014 52 .012 .033 .050		.024 .016 12. .020 .041 .062		10
.034 .014 14 .037 .055 .079		.016 .015 48 .013 .038 .044		.024 .017 11. .028 .042 .055		0
.038 .018 54 .032 .047 .101		.021 .012 20 .016 .036 .045		.035 .017 12. .033 .049 .067		90S
				.006 .079 55 .031 .085 .309		80
				.009 .036 87 .055 .121 .176		70
						60
						50
						40
						30
						20
						10
						0
						90S

TABLE VII. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					.080 .020 22 .090 .096 .119
40	.097 .046 195 .086 .123 .239		.051 1	.118 .061 33 .097 .185 .249	
30	.069 .026 536 .063 .083 .143	.051 1	.045 .017 55 .044 .058 .085	.046 .020 25 .041 .052 .110	
20	.059 .021 105 .053 .073 .116	.048 .016 476 .046 .064 .082	.043 .016 32 .042 .056 .060	.040 .006 10 .039 .046 .048	
10		.032 .011 233 .030 .039 .070	.026 .011 19 .024 .036 .051	.036 .011 17 .037 .048 .051	
0		.028 .008 172 .027 .036 .049	.017 .005 34 .017 .022 .024	.024 .007 26 .025 .031 .032	
10		.033 .007 86 .032 .040 .046	.022 .006 180 .021 .027 .037	.025 .006 43 .023 .030 .036	
20		.037 .011 74 .037 .043 .073	.030 .009 192 .029 .037 .053	.031 .012 52 .029 .040 .073	
30	.060 1	.048 .016 20 .042 .069 .076	.054 .029 337 .048 .075 .118	.050 .030 131 .043 .075 .125	
40			.077 .050 211 .063 .105 .289	.087 .056 120 .066 .122 .280	
50				.286 .102 5 .346 .372 .380	
60					
70					
80					
90S					

DATA FOR SUMMER AT FL 285 TO 335

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.156 .050 25 .157 .202 .258	.129 .024 4 .113 .139 .163	.092 .038 8 .109 .127 .132	.096 .082 90 .077 .121 .291	.104 .072 149 .081 .139 .255		50
.061 .030 19 .054 .069 .173	.098 .084 50 .075 .107 .393	.087 .049 8 .089 .116 .224	.073 .017 99 .073 .087 .114	.090 .051 481 .079 .116 .249		40
.073 .050 146 .058 .104 .239	.099 .087 29 .064 .124 .246			.069 .036 792 .061 .085 .178		30
.065 .062 155 .048 .084 .284	.058 .024 10 .046 .072 .103			.053 .033 788 .047 .067 .127		20
.028 .010 65 .025 .037 .050				.031 .011 334 .029 .039 .068		10
.025 .013 3 .019 .043 .043		.027 1		.026 .009 238 .025 .034 .048		0
		.030 .004 5 .032 .032 .033		.025 .008 314 .023 .034 .044		10
.042 .010 14 .044 .051 .053				.032 .010 332 .031 .040 .061		20
				.053 .029 481 .045 .075 .119		30
				.031 .053 331 .064 .110 .280		40
				.286 .102 5 .346 .372 .380		50
						60
						70
						80
						90S

TABLE VIII. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50.	84	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.142 .081 15 .140 .232 .227	
50				.255 .136 151 .250 .396 .530	
40	.137 .074 157 .112 .209 .315		.089 .063 29 .065 .139 .247	.146 .165 457 .117 .408 .524	
30	.071 .053 727 .054 .086 .256		.059 .039 135 .049 .069 .186	.084 .063 107 .051 .126 .314	
20	.047 .011 65 .044 .760 .072	.044 .019 110 .040 .061 .094	.043 .020 17 .048 .057 .081	.032 .013 49 .031 .043 .063	
10		.030 .010 153 .029 .038 .059	.024 .008 54 .023 .030 .039		
0		.026 .009 138 .026 .032 .046	.021 .007 42 .021 .027 .035	.020 .008 130 .021 .025 .038	
10		.026 .007 67 .025 .032 .043	.022 .008 154 .021 .030 .039	.022 .007 226 .022 .027 .035	
20	.033 1	.031 .007 69 .029 .036 .050	.031 .013 171 .029 .043 .068	.027 .009 154 .026 .034 .050	
30	.071 .018 15 .068 .089 .112	.037 .007 15 .038 .042 .053	.059 .047 202 .048 .078 .165	.052 .040 177 .044 .075 .183	
40		.051 .003 7 .050 .054 .057	.128 .087 363 .101 .192 .410	.129 .066 156 .121 .197 .302	
50				.188 .073 6 .144 .266 .310	
60					
70					
80					
90S					

DATA FOR SUMMER AT FL 335 TO 385

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
		.550 .041 4 .570 .558 .610	.557 .005 6 .555 .562 .564	.554 .026 10 .555 .562 .610		70
.259 .145 77 .274 .413 .455	.367 .192 104 .359 .413 .666	.479 .160 35 .534 .631 .661	.341 .198 52 .324 .557 .603	.335 .191 283 .324 .563 .661		60
.249 .147 218 .275 .427 .525	.272 .153 314 .267 .454 .534	.226 .180 104 .156 .494 .547	.185 .136 270 .123 .319 .558	.242 .153 1059 .218 .414 .537		50
.158 .144 342 .062 .374 .418	.146 .124 393 .095 .273 .506	.127 .103 217 .090 .193 .518	.143 .077 89 .124 .203 .354	.158 .135 1684 .096 .342 .494		40
.074 .067 659 .055 .101 .325	.125 .088 150 .096 .208 .376	.053 1		.078 .068 1379 .058 .107 .323		30
.056 .047 727 .048 .075 .138	.051 .011 5 .049 .052 .072			.053 .042 973 .045 .070 .133		20
.028 .015 132 .026 .037 .060	.035 .011 8 .037 .047 .050	.029 .006 5 .028 .030 .039		.029 .012 352 .027 .037 .059		10
.023 .011 114 .020 .030 .058		.028 .006 11 .028 .032 .044		.023 .009 437 .022 .031 .047		0
				.023 .007 441 .022 .029 .039		10
.032 .004 12 .032 .034 .040				.030 .011 406 .028 .038 .061		20
				.056 .043 409 .046 .077 .183		30
				.127 .081 526 .104 .194 .348		40
				.188 .073 6 .144 .266 .310		50
						60
						70
						80
						90S

TABLE IX. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.409 .115 44 .432 .525 .545	
50				.337 .140 401 .366 .483 .548	
40	.219 .131 31 .183 .350 .514		.129 .105 104 .092 .231 .504	.182 .133 440 .138 .332 .497	
30	.084 .042 30 .081 .092 .167		.084 .082 148 .066 .088 .377	.071 .044 97 .057 .100 .194	
20	.054 .005 4 .050 .053 .062			.041 .027 24 .034 .048 .149	
10		.019 .008 24 .020 .026 .034	.032 .005 9 .032 .038 .039		
0		.019 .007 13 .022 .023 .025	.024 .002 5 .025 .025 .027	.024 .012 3 .018 .041 .041	
10				.022 .004 6 .021 .025 .030	
20			.017 .002 10 .018 .018 .021	.028 .006 28 .027 .035 .037	
30			.022 .002 14 .023 .024 .026	.042 .040 23 .045 .071 .215	
40			.113 .040 26 .119 .151 .171	.201 .115 77 .184 .315 .443	
50					
60					
70					
80					
90S					

DATA FOR SUMMER AT FL 385 TO 435

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.511 .091 21 .550 .594 .631	.474 .147 34 .500 .629 .671			.488 .130 55 .532 .611 .671	70
.354 .171 276 .370 .527 .613	.530 .113 251 .546 .642 .714	.535 .135 351 .575 .656 .727	.410 .152 162 .425 .582 .636	.464 .163 1084 .503 .623 .704		60
.334 .150 197 .329 .497 .615	.428 .163 330 .449 .599 .682	.359 .150 279 .353 .522 .633	.353 .142 497 .353 .507 .629	.363 .151 1694 .369 .522 .639		50
.220 .141 322 .188 .308 .524	.255 .149 551 .236 .410 .586	.192 .119 279 .153 .314 .505	.250 .134 79 .266 .407 .492	.214 .141 1806 .177 .381 .521		40
.128 .128 218 .080 .162 .514	.112 .075 116 .096 .158 .348	.104 .024 10 .105 .132 .146		.103 .097 619 .076 .144 .485		30
.075 .081 125 .051 .097 .393	.048 .011 14 .050 .058 .062	.078 1		.068 .072 168 .048 .090 .391		20
.032 .015 47 .031 .051 .059	.015 .006 5 .016 .017 .024			.026 .014 85 .026 .039 .059		10
.029 .019 28 .027 .044 .064				.025 .016 49 .023 .041 .064		0
.029 .005 18 .030 .032 .039				.028 .005 24 .028 .032 .038		10
				.025 .007 38 .025 .034 .037		20
				.047 .037 37 .040 .065 .123		30
				.172 .105 103 .148 .265 .443		40
						50
						60
						70
						80
						90S

TABLE X. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.105 .052 19 .085 .180 .231	
40	.083 .040 33 .065 .120 .172		.069 .030 9 .055 .123 .126	.110 .030 26 .102 .133 .166	
30	.062 .025 107 .053 .081 .124		.060 .024 55 .054 .081 .119	.109 .018 7 .109 .133 .134	
20	.056 .014 32 .050 .073 .081	.050 .017 54 .047 .068 .079	.041 .014 4 .042 .050 .054		
10		.035 .021 77 .030 .041 .065	.027 .014 19 .027 .043 .053	.011 .005 8 .014 .014 .014	
0		.027 .007 51 .026 .035 .041	.011 .038 20 .013 .021 .024	.013 .008 42 .012 .017 .035	
10		.027 .003 19 .027 .030 .032	.028 .013 74 .027 .041 .062	.023 .019 85 .021 .031 .065	
20		.049 .014 16 .044 .057 .083	.043 .028 63 .030 .077 .103	.026 .025 61 .020 .038 .120	
30		.062 .013 5 .055 .075 .080	.074 .026 110 .079 .098 .116	.066 .044 122 .060 .096 .226	
40	.031 .004 5 .030 .032 .038		.085 .044 60 .078 .105 .179	.050 .063 92 .072 .117 .264	
50				.051 .023 18 .048 .075 .083	
60				.048 .025 20 .040 .068 .121	
70			.017 1	.045 .033 8 .026 .086 .113	
80					
90S					

DATA FOR AUTUMN AT FL 285 TO 335

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.099 .061 32 .063 .163 .227	.153 .047 6 .128 .188 .232	.114 .066 81 .090 .194 .210	.085 .054 147 .061 .128 .213	.093 .060 285 .069 .183 .231		50
.126 .071 24 .087 .214 .237	.062 .042 65 .050 .094 .184	.065 .042 187 .052 .087 .214	.069 .039 66 .050 .100 .162	.072 .045 410 .055 .102 .217		40
.041 .017 96 .036 .059 .080	.055 .025 22 .054 .075 .104	.066 .001 2 .065 .066 .064		.055 .026 289 .049 .078 .122		30
.036 .032 92 .031 .053 .126	.048 .014 15 .053 .059 .067			.044 .026 107 .043 .066 .095		20
.021 .013 49 .016 .034 .048	.057 .015 11 .063 .066 .071	.039 .007 8 .037 .040 .054		.031 .020 172 .029 .041 .069		10
.024 .012 16 .022 .036 .045	.041 1	.036 .004 5 .037 .038 .039		.020 .011 135 .021 .032 .042		0
.046 .018 16 .043 .057 .091				.027 .017 194 .025 .040 .070		10
				.036 .027 140 .028 .065 .103		20
		.053 1		.073 .037 238 .071 .098 .149		30
				.036 .056 157 .073 .113 .264		40
				.051 .023 18 .048 .075 .083		50
				.048 .025 20 .040 .060 .121		60
				.042 .032 9 .026 .086 .113		70
						80
						90S

TABLE XI. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.174 .024 5 .180 .185 .202	
50				.221 .100 229 .238 .333 .385	
40	.090 .047 75 .080 .121 .234		.075 .056 49 .059 .107 .213	.102 .080 495 .073 .170 .338	
30	.084 .041 95 .075 .124 .196		.068 .055 181 .050 .102 .257	.091 .061 56 .070 .148 .232	
20	.079 .025 19 .083 .097 .123	.057 .022 56 .049 .080 .102	.047 .020 23 .051 .058 .097	.074 .020 11 .069 .095 .104	
10		.036 .016 61 .033 .042 .088	.038 .016 26 .039 .054 .066		
0		.022 .014 33 .025 .030 .044	.019 .010 33 .015 .029 .043	.020 .008 112 .019 .027 .039	
10		.032 .004 7 .032 .035 .038	.030 .024 62 .025 .056 .084	.021 .009 117 .020 .031 .039	
20		.046 .025 12 .029 .085 .086	.042 .026 76 .037 .071 .094	.022 .016 168 .016 .031 .082	
30		.080 .006 4 .074 .083 .088	.059 .040 103 .050 .101 .138	.085 .063 228 .080 .140 .248	
40	.051 .006 13 .054 .056 .060		.162 .108 116 .142 .265 .431	.109 .074 148 .094 .139 .357	
50	.055 .023 61 .049 .060 .129		.101 .048 23 .068 .154 .197	.248 .072 16 .258 .300 .393	
60	.205 .083 50 .151 .307 .768		.139 .058 9 .171 .182 .191	.101 .053 28 .043 .145 .229	
70	.401 .027 51 .399 .430 .447		.045 .006 4 .040 .043 .055	.084 .014 13 .079 .097 .107	
80	.521 .055 54 .322 .382 .390				
90S	.262 .022 20 .254 .292 .301				

DATA FOR AUTUMN AT FL 335 TO 385

165W	120W	75W	30W	15E	MEAN	LAT
.280 .015 4 .283 .291 .292				.280 .015 4 .283 .291 .292		90N
.298 .035 50 .305 .329 .358				.298 .035 50 .305 .329 .358		80
.251 .082 218 .261 .316 .416	.203 .096 127 .219 .294 .375	.298 .022 3 .302 .322 .322	.229 .133 17 .231 .381 .388	.233 .093 370 .250 .316 .339		70
.220 .078 154 .232 .301 .360	.167 .102 393 .140 .277 .361	.107 .076 364 .075 .186 .337	.108 .064 505 .093 .172 .290	.148 .096 1647 .126 .256 .362		60
.133 .089 225 .119 .215 .362	.104 .081 502 .071 .196 .313	.090 .069 462 .061 .151 .322	.087 .040 118 .077 .131 .140	.101 .076 1926 .071 .177 .327		50
.059 .033 744 .053 .086 .142	.075 .065 150 .052 .124 .284	.059 .068 26 .035 .043 .234	.090 .049 56 .061 .150 .160	.067 .046 1308 .056 .101 .206		40
.040 .025 540 .035 .065 .101	.052 .004 6 .053 .054 .055	.032 .007 29 .031 .037 .047	.054 .007 55 .052 .061 .071	.043 .025 789 .040 .067 .102		30
.019 .010 114 .018 .026 .052	.050 .009 28 .047 .062 .063	.047 .020 27 .048 .064 .092		.031 .018 260 .026 .050 .075		20
.026 .012 36 .021 .042 .048		.058 .017 25 .056 .084 .089		.025 .016 239 .021 .036 .065		10
.031 .004 8 .029 .037 .041		.049 .009 20 .050 .060 .065		.027 .017 214 .023 .041 .070		0
		.049 .005 27 .050 .053 .055		.031 .022 283 .025 .051 .069		10
		.057 .027 6 .041 .083 .100		.077 .058 341 .074 .121 .234		20
				.126 .094 277 .096 .187 .421		30
				.099 .086 100 .057 .172 .343		40
				.164 .087 87 .141 .276 .331		50
				.320 .144 68 .392 .419 .447		60
				.321 .055 54 .322 .382 .390		70
				.262 .022 20 .254 .242 .301		80
						90S

TABLE XII. - GASP AMBIENT OZONE

Code:

Mean	St. Dev.	N
50	84	98

LAT	15E	60E	105E	150E	165W
90N	.399 .008 3 .405 .405 .405				
80					
70					
60				.396 .094 83 .384 .425 .545	
50				.314 .122 646 .324 .431 .552	
40	.149 .080 70 .111 .255 .299		.199 .144 171 .162 .338 .629	.199 .142 750 .160 .336 .582	
30			.102 .080 276 .077 .154 .325	.048 .033 131 .067 .094 .141	
20			.057 .023 13 .068 .083 .083		
10		.036 .012 5 .039 .043 .050	.034 .013 21 .029 .048 .061	.020	1
0		.031 .011 6 .034 .035 .043	.024 .005 9 .022 .031 .034	.020 .002 4 .019 .021 .022	
10				.019 .006 16 .015 .023 .031	
20				.038 .029 65 .031 .049 .119	
30	.082 .001 6 .083 .083 .083			.084 .044 41 .084 .115 .170	
40	.104 .019 16 .097 .113 .151		.135 .066 31 .097 .208 .259	.252 .147 117 .211 .435 .535	
50			.178 .057 9 .212 .224 .224	.404 .175 52 .335 .579 .774	
60				.825 .138 49 .875 .931 .928	
70				.547 .099 49 .528 .658 .741	
80				.342 .041 51 .404 .435 .425	
90S	.145 .030 35 .359 .374 .399			.374 .040 56 .378 .418 .440	

DATA FOR AUTUMN AT FL 385 TO 435

165W	120W	75W	30W	15E	MEAN	LAI
.304 .029 40 .324 .027 .447	.363 .034 12 .364 .034 .135		.413 .029 57 .410 .029 .477	.490 .034 112 .489 .034 .476		90N
			.491 .057 41 .480 .057 .582	.491 .057 41 .480 .057 .582		80
.305 .113 376 .321 .395 .544	.291 .103 43 .267 .404 .523	.401 .064 20 .416 .454 .479	.360 .096 98 .366 .422 .615	.327 .111 620 .316 .425 .574		70
.277 .123 492 .235 .340 .541	.279 .111 237 .254 .377 .543	.275 .133 434 .265 .312 .524	.259 .101 458 .257 .369 .458	.284 .121 2171 .254 .450 .542		60
.166 .101 572 .141 .261 .406	.191 .125 592 .150 .317 .524	.188 .123 454 .152 .343 .459	.205 .146 37 .144 .323 .475	.187 .126 2608 .151 .321 .526		50
.093 .049 215 .085 .136 .208	.086 .066 222 .064 .122 .327	.096 .088 40 .079 .149 .285		.089 .064 814 .074 .131 .307		40
.045 .026 137 .064 .082 .134	.056 .016 9 .062 .071 .074	.042 .015 42 .037 .058 .054	.047 .001 3 .047 .048 .048	.059 .025 204 .057 .080 .123		30
.034 .016 117 .029 .049 .073		.057 .024 44 .047 .084 .107	.049 .002 45 .049 .051 .052	.041 .019 233 .041 .052 .096		20
.024 .012 93 .021 .044 .075		.052 .019 56 .061 .077 .102	.050 .007 62 .048 .049 .061	.041 .020 234 .041 .059 .093		10
.024 .012 64 .018 .042 .049		.065 .019 61 .067 .083 .107	.047 .005 47 .048 .050 .053	.043 .023 234 .043 .050 .093		0
		.055 .013 75 .054 .068 .081	.071 .017 50 .077 .067 .089	.043 .024 190 .052 .062 .103		10
		.070 .016 6 .040 .084 .100	.067 .010 38 .053 .004 .090	.074 .032 41 .076 .102 .156		20
				.216 .140 164 .151 .378 .517		30
				.392 .173 54 .334 .574 .774		40
				.825 .138 48 .875 .401 .938		50
				.547 .094 49 .526 .658 .741		60
				.372 .071 23 .404 .435 .475		70
.141				.384 .075 47 .385 .475 .427		80
						90S

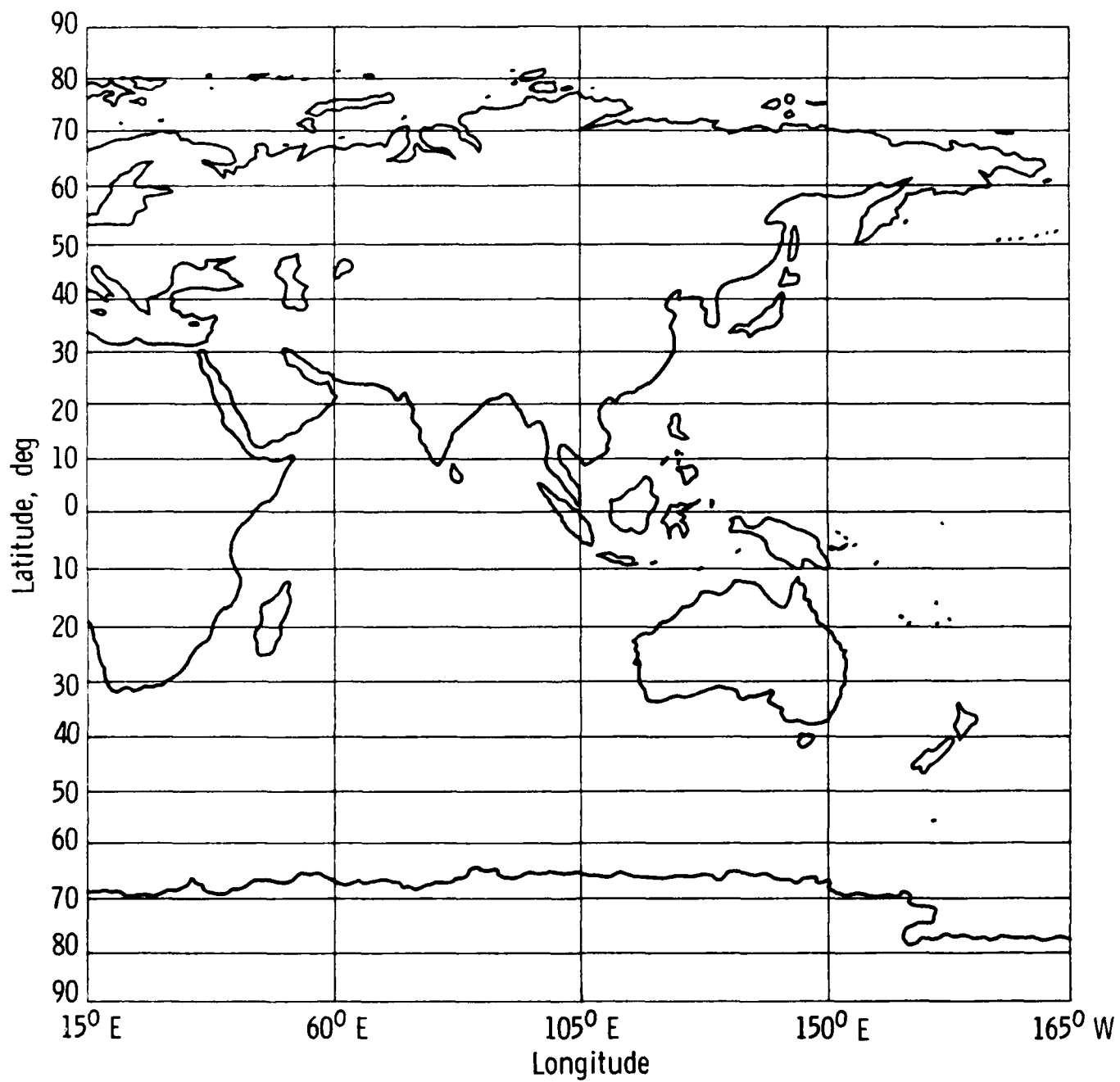
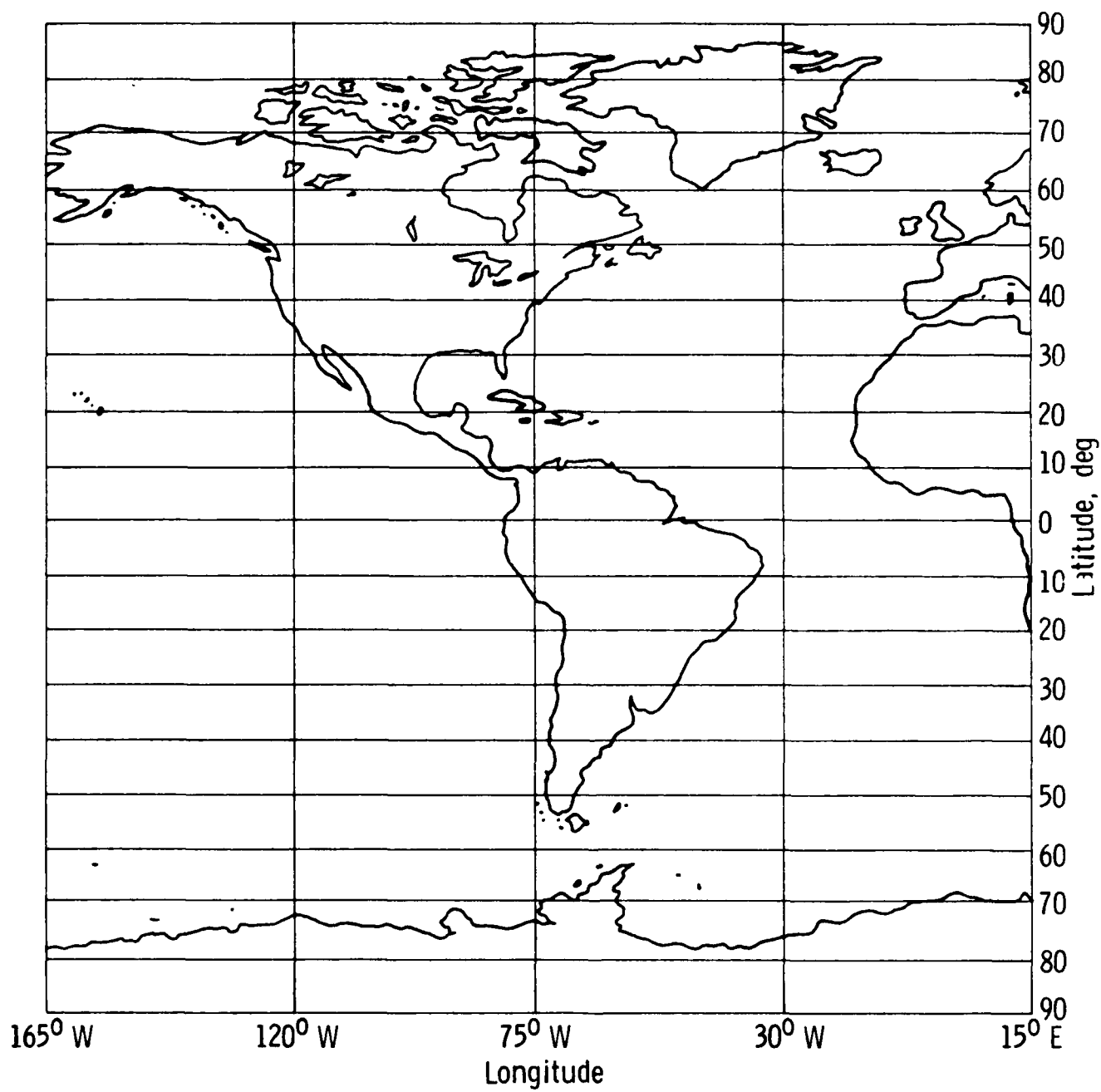


Figure 1. - Geographical grid



used for ozone tabulations.

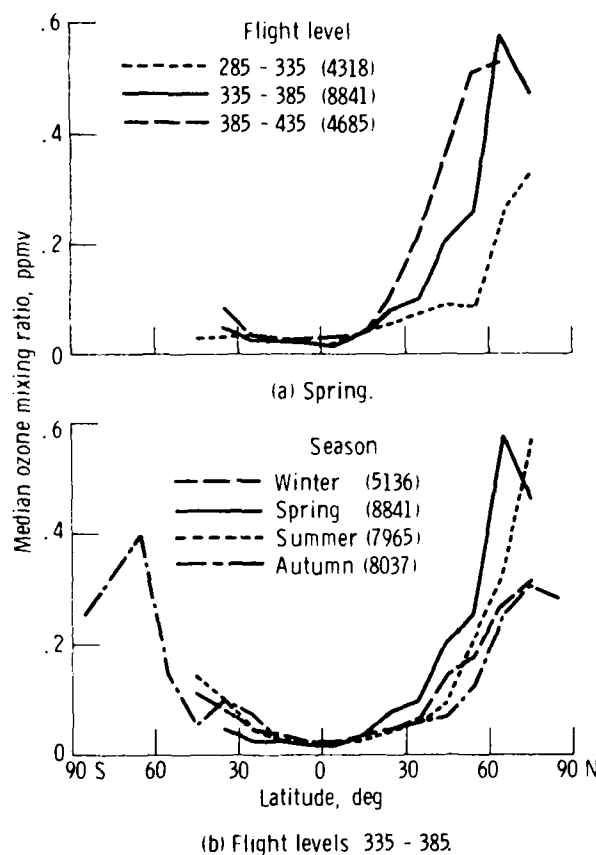


Figure 2. - Variation of zonal median (50th percentile) ambient ozone mixing ratio with latitude, flight level, and season. Number of observations is given in parentheses.

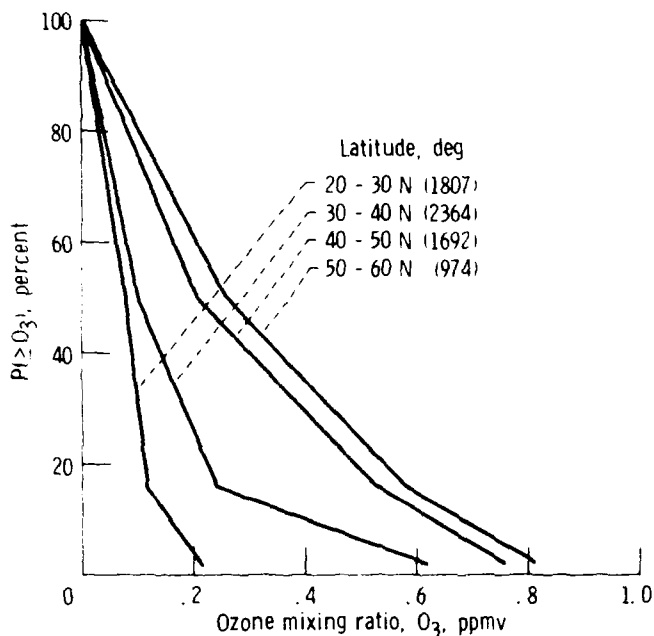


Figure 3. - Ambient ozone cumulative frequency distributions for spring at flight levels, 335 to 385. Number of observations is given in parentheses.

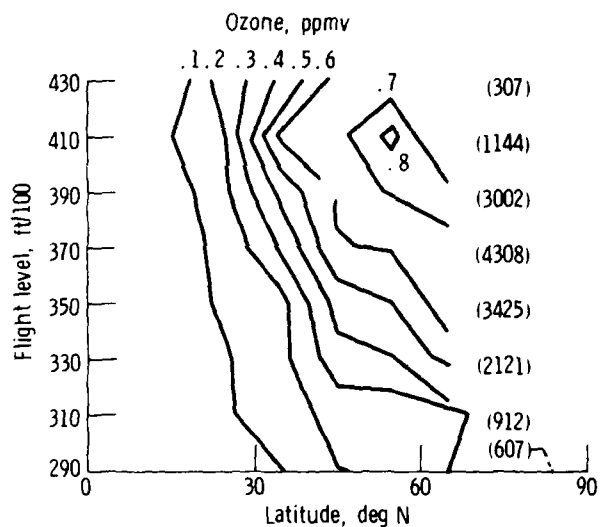


Figure 4. - Northern hemisphere latitude - flight level cross section of zonal 84th percentile ozone mixing ratios. Number observations for each flight level is given in parentheses.

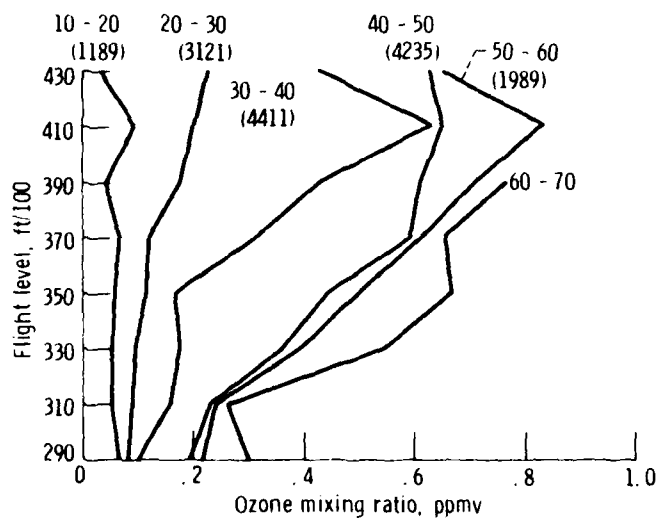


Figure 5. - Vertical profiles of zonal 84th percentile ozone mixing ratios for selected latitudes (in deg N). Number of observations for each latitude is given in parentheses.

APPENDIX A

OZONE UNIT CONVERSION FACTORS

[Multiply "From" units by this factor to get "To" units. All temperatures are in K and all pressures in hectopascals (hPa).]

From	To						
	g/m ³	10 ⁻³ cm STP/km	mol/cm ³	hPa	g/g	ppmv	ppmv SLE
μm ³	1	0.0467	1.26x10 ¹⁰	1.73x10 ⁻³ T	2.87x10 ⁻³ $\frac{T}{P}$	1.73x10 ⁻³ $\frac{T}{P}$	5.09x10 ⁻⁴
10 ⁻³ cm STP/km	21.4	1	2.69x10 ¹¹	0.0370T	0.614 $\frac{T}{P}$	0.0370 $\frac{T}{P}$	0.0109
Molecules/cm ³	7.97x10 ⁻¹¹	5.72x10 ⁻¹²	1	1.38x10 ⁻¹³	2.29x10 ⁻¹³ $\frac{T}{P}$	1.38x10 ⁻¹³ $\frac{T}{P}$	4.06x10 ⁻¹⁴
g/g (ppmw)	340 $\frac{P}{T}$	16.5 $\frac{P}{T}$	4.37x10 ¹² $\frac{P}{T}$	0.603P	1	0.603	0.177 $\frac{P}{T}$
Partial pressure, hPa (mbar)	$\frac{278}{T}$	$\frac{27.0}{T}$	7.25x10 ¹² $\frac{P}{T}$	1	$\frac{1.66}{P}$	$\frac{1}{P}$	$\frac{0.294}{T}$
Parts per million by volume (ppmv)	578 $\frac{P}{T}$	27.0 $\frac{P}{T}$	7.25x10 ¹² $\frac{P}{T}$	P	1.66	1	0.294 $\frac{P}{T}$
Parts per million by volume, sea level equivalent (ppmv SLE)	1.96x10 ³	91.8	2.46x10 ¹³	3.40T	5.64 $\frac{T}{P}$	340 $\frac{T}{P}$	1

APPEN

TABULATIONS OF GASP AMBIENT OZONE DATA BY SEASON

WINTER
FL 290

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.067 .035 .46 .059 .089 .165				
30	.051 .023 .41 .052 .070 .096		.062 1		
20	.054 .037 .31 .046 .065 .132	.049 .015 .10 .046 .051 .084	.034 1		
10		.052 .019 .28 .058 .069 .069	.035 .004 .4 .035 .036 .040		
0		.031 .012 .16 .026 .032 .064			
10			.026 .010 .18 .023 .034 .046		
20			.029 .012 .17 .025 .039 .060	.033 .014 .3 .027 .053 .053	
30	.051 1		.037 .016 .7 .040 .053 .057	.006 1	
40		.054 1	.045 .019 .12 .039 .059 .085	.071 .028 .11 .066 .088 .125	
50					
60					
70					
80					
90S					

DIX B

AND LATITUDE FOR 2000-FOOT ALTITUDE INTERVALS

WINTER
FL 290

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
			.126 .012 3 .126 .141 .141	.126 .012 3 .126 .141 .141		70
			.067 .038 19 .059 .096 .181	.067 .038 19 .059 .096 .181		60
	.111 .083 7 .111 .204 .239	.048 .042 3 .025 .107 .107	.107 .060 14 .072 .179 .225	.078 .052 70 .064 .119 .225		50
.070 .046 10 .035 .056 .302	.046 .020 11 .043 .055 .095			.053 .040 63 .046 .070 .149		40
.042 .018 10 .042 .056 .061				.050 .031 52 .046 .061 .130		30
.036 .011 7 .032 .042 .052				.049 .018 35 .052 .067 .069		20
				.031 .012 15 .026 .032 .064		10
				.026 .010 18 .023 .034 .046		0
.029 .006 2 .023 .035 .035				.029 .012 22 .025 .039 .060		10
				.037 .019 9 .040 .057 .061		20
				.057 .027 24 .052 .085 .125		30
						40
						50
						60
						70
						80
						90S

WINTER
FL 310

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.101 .065 10 .084 .101 .283				
30	.071 .037 55 .062 .113 .141		.045 .042 12 .016 .077 .155		
20	.078 .039 38 .067 .112 .160	.051 .010 43 .053 .060 .066	.012 .011 21 .009 .013 .060		
10		.038 .016 63 .040 .050 .071	.006 .006 2 .009 .012 .012		
0		.038 .017 14 .033 .060 .065		.022 .007 16 .019 .029 .034	
10		.014 .004 4 .013 .015 .019		.025 .003 11 .025 .026 .032	
20		.014 .003 5 .014 .015 .018	.042 .020 12 .039 .046 .100	.017 .015 26 .011 .036 .047	
30	.044 .022 36 .040 .059 .094	.075 .017 19 .073 .091 .105	.068 .031 18 .055 .096 .108	.017 .003 2 .014 .020 .020	
40		.104 1	.084 .059 49 .077 .093 .276	.052 .027 31 .042 .077 .104	
50					
60					
70					
80					
90S					

WINTER
FL 310

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
			.176 .011 2 .165 .187 .187	.176 .011 2 .165 .187 .187		60
.072 1			.117 .078 15 .122 .196 .243	.114 .076 16 .073 .189 .243		50
.037 .025 21 .033 .066 .083	.070 .056 16 .044 .117 .249	.070 .068 3 .026 .166 .166	.115 .111 13 .042 .285 .344	.073 .073 63 .047 .117 .287		40
.058 .055 50 .030 .104 .203	.069 .059 22 .057 .068 .323			.064 .049 139 .050 .105 .193		30
.046 .024 31 .045 .067 .092				.051 .033 133 .050 .073 .147		20
.024 .010 33 .025 .036 .042				.033 .016 98 .032 .047 .068		10
.019 .004 2 .015 .022 .022				.023 .015 32 .025 .045 .060		0
				.022 .006 15 .024 .026 .032		10
				.023 .019 43 .018 .041 .049		20
				.058 .027 75 .054 .091 .108		30
				.072 .051 61 .065 .090 .275		40
						50
						60
						70
						80
						90S

WINTER
FL 330

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.132 .088 24 .096 .254 .298				
30	.079 .048 77 .065 .134 .195		.048 .018 9 .041 .056 .090	.040 .002 2 .038 .041 .041	
20	.100 .041 10 .104 .141 .167	.051 .027 71 .049 .063 .136	.063 .052 2 .011 .114 .114		
10		.048 .018 48 .040 .057 .081	.030 .022 6 .018 .035 .076		
0		.043 .020 44 .036 .069 .086	.023 .011 11 .025 .033 .041		
10		.025 .011 37 .027 .032 .039	.017 .006 14 .017 .021 .025	.021 .002 7 .020 .023 .024	
20		.040 .011 30 .040 .049 .057	.036 .016 15 .037 .049 .078	.026 .016 32 .020 .038 .062	
30	.061 .021 36 .052 .083 .102	.059 .025 17 .054 .068 .130	.050 .018 44 .047 .065 .080	.054 .036 85 .057 .095 .108	
40		.071 .021 19 .077 .090 .098	.085 .041 24 .079 .110 .129	.040 .037 66 .079 .105 .188	
50				.159	1
60					
70					
80					
90S					

WINTER
FL 330

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.312 1	.229 .047 9 .223 .283 .288	.227 .097 46 .224 .299 .441	.166 .050 17 .161 .222 .251	.214 .087 73 .214 .248 .441		70
.244 .045 13 .221 .100 .324	.241 .046 28 .251 .287 .296	.151 .123 44 .119 .303 .383	.140 .111 63 .129 .252 .351	.171 .111 148 .164 .284 .341		60
.053 .015 5 .047 .068 .074	.132 .097 20 .115 .167 .387	.062 .052 47 .037 .136 .170	.112 .104 25 .050 .233 .322	.097 .086 121 .053 .187 .322		50
.064 .075 97 .045 .080 .250	.056 .027 39 .055 .069 .104			.068 .059 224 .052 .040 .205		40
.039 .029 131 .032 .054 .123				.046 .032 214 .037 .067 .141		30
				.046 .019 54 .039 .067 .081		20
.032 1				.039 .020 56 .033 .060 .086		10
				.023 .010 51 .022 .030 .039		0
.034 .016 13 .033 .056 .057				.034 .016 90 .034 .049 .066		10
				.055 .029 144 .052 .098 .104		20
				.080 .036 112 .079 .105 .168		30
				.159 1		40
						50
						60
						70
						80
						90S

WINTER
FL 350

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.115 .149 8 .023 .350 .334	
40	.176 .116 74 .125 .310 .452		.066 .002 2 .064 .067 .067	.091 .020 19 .090 .107 .117	
30	.118 .099 98 .074 .221 .359		.064 .037 8 .045 .112 .135	.062 .031 21 .049 .106 .131	
20	.070 .025 14 .076 .084 .107	.051 .024 62 .046 .079 .102	.066 .018 4 .062 .078 .085		
10	.065 1	.048 .018 52 .048 .064 .060	.024 .019 11 .026 .034 .063	.020 .021 49 .010 .039 .059	
0		.042 .020 51 .038 .065 .081	.020 .010 13 .020 .028 .042	.024 .010 26 .026 .035 .044	
10		.028 .012 17 .029 .035 .063	.023 .016 55 .024 .042 .057	.023 .008 39 .021 .032 .037	
20		.044 .013 12 .042 .054 .064	.040 .019 62 .039 .057 .080	.023 .015 27 .021 .029 .044	
30		.032 .010 17 .030 .036 .056	.060 .023 102 .058 .084 .112	.048 .030 57 .043 .082 .059	
40			.077 .035 81 .071 .101 .136	.081 .034 53 .076 .119 .137	
50				.100 .031 6 .111 .112 .125	
60					
70					
80					
90S					

WINTER
FL 350

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
		.306 .057 9 .313 .339 .402			.306 .057 9 .313 .339 .402	70
.245 .051 6 .294 .327 .339	.280 .057 11 .261 .317 .388	.260 .069 15 .278 .356 .413			.274 .063 32 .273 .339 .388	60
.183 .087 31 .181 .243 .372	.137 .072 70 .110 .215 .307	.314 .154 40 .321 .467 .541	.088 .116 34 .042 .127 .453		.173 .135 183 .131 .321 .504	50
.125 .068 47 .107 .191 .281	.176 .103 170 .170 .288 .377	.204 .216 28 .028 .478 .533	.197 .163 41 .097 .394 .508		.169 .123 381 .123 .295 .462	40
.071 .070 329 .051 .095 .302	.083 .054 130 .066 .118 .223				.081 .074 586 .059 .115 .316	30
.050 .029 428 .043 .070 .138					.050 .026 508 .044 .076 .133	20
.039 .026 43 .035 .064 .107					.035 .024 156 .035 .059 .084	10
.026 .016 15 .019 .051 .054					.033 .019 105 .028 .051 .078	0
					.024 .013 111 .024 .036 .057	10
.041 .017 2 .024 .058 .058					.036 .019 103 .036 .056 .079	20
					.053 .027 206 .049 .082 .102	30
					.074 .034 134 .075 .109 .137	40
					.100 .031 6 .111 .112 .125	50
						60
						70
						80
						90S

WINTER
FL 370

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70				.032	1
60				.302 .219 .65 .303 .549 .755	
50			.597 .142 .6 .485 .728 .801	.469 .140 .39 .497 .624 .649	
40			.232 .103 .19 .242 .318 .399	.329 .177 .35 .327 .555 .600	
30	.129 .064 .16 .108 .159 .330				
20	.072 .005 .5 .074 .075 .078	.060 .011 .10 .062 .068 .075			
10		.027 .007 .31 .029 .035 .038	.018 .058 .19 .004 .006 .264		
0		.019 .008 .7 .015 .026 .033		.028 .010 .49 .028 .037 .051	
10				.023 .011 .66 .026 .032 .046	
20			.040 .014 .12 .039 .050 .061	.036 .015 .60 .036 .050 .066	
30	.034 .005 .8 .035 .038 .040	.033 .007 .24 .032 .042 .044	.041 .019 .15 .040 .049 .098	.071 .033 .25 .058 .107 .133	
40		.092 1	.107 .056 .78 .067 .173 .239	.185 .112 .15 .191 .341 .366	
50				.107 .027 .3 .102 .142 .142	
60					
70					
80					
90S					

WINTER
FL 370

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.204 .092 21 .175 .279 .426	.264 .096 33 .294 .175 .396			.237 .102 55 .223 .354 .400		70
.179 .066 40 .168 .234 .332	.246 .157 24 .214 .419 .574	.206 .191 41 .146 .392 .584	.312 .214 59 .233 .581 .741	.260 .195 229 .206 .470 .704		60
.142 .089 30 .104 .245 .284	.167 .125 190 .146 .294 .479	.142 .125 100 .103 .261 .481	.304 .117 21 .337 .399 .526	.203 .165 386 .164 .377 .628		50
.090 .083 379 .061 .142 .351	.126 .087 187 .106 .210 .367			.119 .109 636 .076 .205 .491		40
.065 .040 366 .053 .098 .158				.065 .040 381 .056 .098 .155		30
.039 .021 91 .033 .053 .099				.034 .029 141 .031 .044 .099		20
.028 .006 62 .029 .034 .040				.028 .008 116 .028 .034 .044		10
.031 .008 44 .033 .039 .046				.027 .011 110 .027 .036 .046		0
.025 .002 4 .025 .025 .026				.036 .015 76 .037 .050 .062		10
				.047 .027 77 .040 .062 .122		20
				.119 .073 94 .094 .184 .341		30
				.107 .027 3 .102 .142 .142		40
						50
						60
						70
						80
						90S

WINTER
FL 390

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.364 .191 14 .230 .580 .659	
50				.210 .227 60 .120 .223 .889	
40			.168 .036 6 .166 .176 .232	.130 .056 34 .114 .197 .234	
30			.087 .056 7 .093 .137 .183	.144 .225 5 .035 .036 .595	
20					
10		.009 .004 6 .007 .011 .017	.007 .003 37 .006 .009 .014		
0		.010 .002 3 .009 .013 .013	.015 .003 5 .015 .018 .018	.024 .003 2 .021 .025 .026	
10		.035 .004 2 .030 .039 .039	.027 .013 18 .028 .039 .044	.033 .009 12 .027 .038 .052	
20			.014 .007 5 .010 .022 .024	.037 .016 29 .031 .055 .068	
30		.038 1		.063 .041 23 .088 .095 .116	
40		.060 .024 10 .044 .088 .093	.040 .031 48 .077 .116 .164	.156 .082 23 .115 .247 .279	
50					
60					
70					
80					
90S					

WINTER
FL 390

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.404 .154 .45 .174 .579 .656				.394 .168 .59 .374 .580 .654		70
.373 .173 .39 .366 .578 .642	.227 .030 .6 .209 .258 .277	.449 1	.359 .051 .7 .335 .401 .429	.278 .241 .113 .201 .558 .809		60
.112 .054 .37 .102 .169 .209	.205 .132 .203 .174 .138 .564	.141 .197 .51 .046 .430 .625	.356 .154 .28 .351 .526 .551	.190 .147 .361 .149 .339 .570		50
.115 .088 .197 .088 .174 .365	.154 .089 .235 .134 .250 .375			.136 .093 .444 .110 .224 .375		40
.085 .053 .227 .074 .134 .222				.085 .053 .227 .074 .134 .222		30
.037 .017 .56 .033 .057 .076				.024 .020 .49 .020 .039 .072		20
.028 .008 .82 .028 .033 .042				.026 .008 .92 .027 .033 .042		10
.028 .007 .48 .027 .032 .047				.029 .004 .80 .028 .037 .047		0
.028 .010 .19 .023 .035 .051				.032 .015 .53 .026 .051 .068		10
				.052 .040 .24 .080 .095 .116		20
				.105 .061 .41 .090 .162 .252		30
						40
						50
						60
						70
						80
						90S

WINTER
FL 410

Code:	Mean	St. Dev.	N
	50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.217	1
50				.572 .372 60 .533 .921 1.240	
40			.340 .294 35 .142 .689 .900	.371 .317 45 .169 .830 .935	
30			.178 .225 23 .063 .534 .657	.401 .163 36 .354 .489 .753	
20			.021	1	
10			.015 .005 10 .014 .020 .023		
0		0.000 1	.008 .004 9 .008 .011 .015	.024 .039 6 .025 .032 .036	
10				.030 .013 47 .029 .045 .055	
20				.035 .014 38 .032 .053 .057	
30				.111 .040 22 .125 .145 .175	
40				.199 .079 82 .184 .280 .322	
50					
60					
70					
80					
90S					

WINTER
FL 410

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
				.217	1	60
.457 .086 11 .460 .533 .566	.445 .150 30 .448 .516 .805			.522 .306 101 .486 .901 1.198		50
	.305 .209 130 .241 .520 .893			.325 .252 210 .218 .623 .926		40
.207 .129 84 .187 .332 .568	.254 .243 48 .157 .274 .871			.252 .197 191 .199 .446 .774		30
.116 .069 105 .105 .183 .247				.116 .069 106 .104 .183 .267		20
.042 .026 59 .029 .059 .122				.038 .026 69 .028 .056 .122		10
.027 .008 37 .026 .037 .045				.023 .011 53 .024 .035 .045		0
.029 .006 11 .029 .034 .037				.030 .012 58 .029 .043 .055		10
.045 .026 31 .037 .087 .096				.039 .021 69 .032 .055 .096		20
				.111 .040 22 .125 .145 .175		30
				.199 .073 42 .184 .280 .322		40
						50
						60
						70
						80
						90S

WINTER
FL 430

Code:

Mean	St. Dev.	N
502	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.621 .127 5 .573 .765 .780	
40			.241 .098 7 .210 .300 .457	.715 .194 6 .594 .851 1.040	
30			.068 .077 13 .027 .198 .218		
20			.015 .003 16 .014 .018 .019		
10			.014 .002 4 .011 .016 .016		
0		.010 1	.010 .003 10 .011 .012 .016	.020 1	
10				.025 .003 12 .025 .026 .030	
20				.035 .021 16 .025 .080 .079	
30				.111 .000 4 .106 .111 .125	
40				.191 .125 45 .148 .330 .432	
50					
60					
70					
80					
90S					

WINTER
FL 430

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
				.621 .127 5 .573 .765 .780		50
	.311 .308 35 .150 .768 .864	.587 1		.356 .306 49 .203 .780 .887		40
.295 .190 68 .219 .542 .645	.092 .046 38 .106 .126 .139			.205 .181 119 .137 .447 .644		30
.043 .023 17 .033 .040 .106				.029 .022 33 .025 .038 .097		20
.033 .014 7 .027 .054 .057				.026 .015 11 .022 .028 .057		10
.019 .002 7 .020 .020 .023				.014 .005 19 .012 .020 .023		0
				.025 .003 12 .025 .026 .030		10
.044 .022 52 .036 .065 .086				.042 .022 68 .032 .065 .086		20
				.111 .008 4 .106 .111 .125		30
				.191 .103 45 .148 .330 .432		40
						50
						60
						70
						80
						90S

SPRING
FL 290

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.107 .093 43 .057 .213 .345				
30	.042 .042 62 .070 .096 .231		.078 .044 27 .062 .101 .169	.111 .062 2 .049 .172 .172	
20	.044 .006 2 .038 .050 .050	.045 .011 10 .043 .050 .067	.033 .015 25 .033 .052 .054		
10		.047 .023 15 .050 .062 .109	.046 .011 13 .050 .056 .061	.018 .001 2 .017 .018 .018	
0		.024 .005 7 .024 .025 .035	.021 .007 11 .014 .028 .034	.017 .002 5 .017 .019 .019	
10			.024 .007 21 .022 .031 .038		
20			.028 .004 15 .029 .031 .035	.024 .012 5 .027 .028 .043	
30	.028 .015 2 .013 .043 .043	.027 1	.036 .006 10 .035 .036 .050	.038 .013 40 .038 .049 .063	
40			.033 .009 11 .034 .040 .048	.034 .029 34 .034 .046 .063	
50				.025 1	
60					
70					
80					
90S					

SPRING
FL 290

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
		.279 .033 11 .287 .300 .347		.279 .033 11 .287 .300 .347		60
		.047 .009 7 .049 .055 .050	.128 .109 51 .078 .222 .385	.118 .105 58 .067 .216 .385		50
.123 .086 15 .079 .231 .111	.127 .110 25 .090 .198 .463	.116 .082 54 .085 .191 .362	.084 .077 25 .063 .075 .368	.111 .090 162 .010 .198 .365		40
.067 .039 53 .066 .083 .128	.110 .059 16 .076 .177 .242	.061 .011 9 .060 .073 .076		.078 .045 159 .067 .098 .237		30
.070 .027 64 .073 .095 .140	.040 .013 17 .038 .052 .064	.052 .011 6 .047 .053 .075		.055 .027 124 .051 .082 .104		20
.037 .025 23 .021 .064 .074	.023 1	.019 .002 3 .020 .021 .021		.040 .022 57 .043 .063 .074		10
	.017 1	.078 .019 2 .059 .097 .097		.025 .017 28 .019 .029 .055		0
				.024 .007 21 .022 .031 .038		10
		.031 1		.027 .007 21 .028 .031 .043		20
		.014 .005 3 .010 .022 .022		.036 .013 56 .036 .048 .063		30
				.038 .025 45 .034 .045 .063		40
				.025 1		50
						60
						70
						80
						90S

SPRING
FL 310

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.098 .053 10 .064 .172 .222			.167 .077 9 .143 .258 .319	
30	.094 .070 69 .066 .138 .289		.095 .031 17 .079 .114 .171	.195 .064 9 .166 .260 .337	
20	.046 .009 30 .042 .052 .065	.066 .029 67 .057 .093 .135	.074 .022 23 .084 .095 .108	.052 .026 19 .045 .055 .139	
10		.041 .010 38 .042 .048 .061	.041 .017 8 .046 .053 .059	.016 .002 2 .013 .018 .018	
0		.024 .011 16 .022 .033 .046	.023 1	.015 .006 38 .016 .020 .027	
10		.039 .005 7 .038 .040 .050	.027 .006 26 .026 .033 .035	.017 .006 25 .017 .022 .028	
20		.036 .012 11 .029 .049 .056	.034 .007 11 .034 .039 .049	.017 .005 18 .015 .023 .024	
30	.045 .011 22 .044 .057 .060	.036 .001 2 .035 .037 .037	.037 .009 64 .035 .045 .061	.031 .013 4 .023 .041 .046	
40			.030 .024 67 .031 .042 .127	.050 .044 54 .031 .053 .193	
50				.032 .002 4 .030 .033 .035	
60					
70					
80					
90S					

SPRING
FL 310

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
			.328 .033 3 .321 .371 .371	.328 .033 3 .321 .371 .371		70
.109 1			.239 .028 11 .736 .263 .299	.235 .029 12 .230 .263 .299		60
.433 1	.195 .142 12 .118 .363 .465	.236 .047 6 .230 .253 .320	.088 .056 56 .068 .120 .258	.121 .099 75 .075 .230 .433		50
.145 .146 32 .074 .383 .441	.126 .102 116 .087 .225 .441	.156 .133 36 .097 .283 .411	.060 .014 5 .055 .073 .078	.133 .113 210 .087 .232 .441		40
.090 .098 80 .067 .085 .447	.126 .119 23 .065 .211 .492	.154 1		.097 .090 199 .070 .161 .360		30
.060 .032 83 .054 .084 .110	.055 1	.035 .001 3 .036 .036 .036		.060 .029 226 .053 .090 .125		20
.038 .014 46 .042 .057 .077	.019 .011 16 .019 .024 .054	.023 .005 11 .022 .025 .033		.035 .016 121 .034 .051 .066		10
.023 1	.008 1	.022 .013 9 .029 .035 .039		.014 .010 66 .017 .027 .044		0
		.029 .005 12 .031 .032 .037		.025 .009 76 .024 .034 .040		10
		.028 .007 20 .028 .033 .040		.027 .011 60 .027 .035 .054		20
		.013 1		.038 .011 94 .037 .049 .061		30
				.042 .030 121 .031 .049 .191		40
				.032 .002 4 .030 .033 .035		50
						60
						70
						80
						90S

SPRING
FL 330

Code:

Mean	Std. Dev.	N
50	84	98

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.532 .117 14 .551 .633 .683	
40	.104 .092 29 .078 .153 .287		.073 .010 3 .071 .086 .085	.145 .150 63 .076 .323 .613	
30	.104 .100 116 .060 .184 .409		.158 .168 19 .073 .176 .542	.181 .151 20 .101 .398 .527	
20	.047 .005 1 .048 .053 .053	.057 .016 76 .051 .071 .094	.050 .005 4 .047 .039 .058	.056 .007 23 .055 .059 .080	
10		.033 .016 25 .029 .054 .061	.034 .013 54 .037 .050 .070	.037 .021 79 .032 .053 .087	
0		.031 .011 44 .027 .045 .043	.047 .016 4 .048 .050 .061	.018 .005 25 .018 .022 .033	
10		.028 .007 17 .027 .036 .038	.038 .005 2 .040 .035 .035	.013 .007 39 .014 .018 .022	
20		.035 .007 13 .038 .040 .043	.040 .007 15 .038 .043 .056	.022 .007 54 .023 .029 .033	
30	.014 .013 16 .017 .023 .042	.043 .007 21 .045 .050 .055	.042 .006 10 .033 .037 .040	.030 .015 101 .027 .042 .063	
40		.045 .008 10 .042 .045 .064	.047 .013 23 .049 .046 .057	.052 .040 74 .038 .064 .163	
50				.037 .010 6 .028 .047 .038	
60					
70					
80					
90S					

SPRING
FL 330

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
.265 1	.331 .162 23 .312 .530 .613	.543 .073 7 .566 .586 .647	.111 .047 13 .095 .136 .238	.298 .189 44 .251 .545 .613		60
.265 .119 6 .263 .329 .458	.397 .138 26 .428 .518 .567	.157 .145 91 .084 .280 .565	.144 .129 173 .083 .273 .492	.190 .168 310 .101 .392 .602		50
.246 .177 36 .180 .476 .556	.172 .142 75 .116 .297 .545	.178 .157 256 .092 .396 .527	.089 .060 29 .068 .166 .248	.168 .152 491 .095 .363 .545		40
.097 .083 294 .074 .111 .386	.214 .201 61 .102 .502 .639	.098 .020 6 .090 .110 .135		.118 .121 516 .077 .176 .560		30
.074 .052 272 .067 .095 .181	.068 .042 76 .056 .112 .146	.118 .067 7 .090 .160 .266		.069 .052 461 .060 .093 .175		20
.036 .024 11 .027 .053 .117	.020 .011 11 .017 .023 .044	.037 .011 24 .037 .045 .061		.035 .019 211 .032 .052 .063		10
.013 1	.014 .020 2 .014 .014 .014	.029 .010 12 .025 .036 .055		.027 .012 88 .023 .040 .055		0
				.018 .010 58 .016 .027 .037		10
				.027 .011 92 .026 .038 .048		20
		.014 .008 4 .010 .015 .027		.031 .015 160 .030 .045 .061		30
				.008 .034 117 .039 .055 .163		40
				.037 .010 6 .028 .047 .048		50
						60
						70
						80
						90S

SPRING
FL 350

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.404 .261 22 .486 .638 .831	
40	.184 .174 57 .079 .426 .501			.204 .178 49 .099 .458 .604	
30	.157 .126 107 .124 .253 .461	.190 1	.109 .086 16 .082 .128 .394	.118 .066 12 .089 .134 .289	
20	.128 .011 5 .130 .132 .145	.080 .055 70 .062 .097 .260	.072 .025 8 .065 .097 .100	.063 .032 168 .057 .089 .146	
10		.033 .017 30 .033 .043 .065	.038 .020 90 .037 .058 .072	.050 .026 106 .046 .070 .110	
0		.023 .010 34 .019 .038 .043	.025 .008 16 .022 .034 .034	.017 .006 29 .017 .021 .029	
10		.026 .007 32 .025 .032 .037	.022 .008 27 .021 .032 .034	.018 .008 43 .015 .024 .034	
20		.028 .006 20 .027 .033 .043	.031 .011 37 .031 .045 .052	.019 .011 54 .016 .023 .042	
30		.048 .039 13 .040 .062 .153	.034 .012 30 .030 .048 .056	.028 .018 114 .023 .043 .077	
40			.044 .033 26 .037 .048 .065	.053 .024 47 .050 .077 .097	
50					
60					
70					
80					
90S					

SPRING
FL 350

165W	120W	75W	30W	15E	MEAN	LAT
						90N
	.436 .072 9 .416 .520 .557	.528 .084 14 .487 .641 .695	.451 .015 3 .452 .469 .469	.488 .087 26 .469 .560 .681		80
.507 .277 15 .497 .768 .807	.618 .742 14 .616 .704 .756	.525 .103 36 .512 .637 .677	.157 .042 4 .136 .150 .227	.519 .183 69 .553 .070 .776		70
.445 .233 46 .535 .679 .739	.223 .158 56 .153 .404 .633	.267 .188 124 .225 .494 .651	.175 .148 197 .106 .273 .593	.246 .198 449 .164 .503 .698		60
.248 .202 73 .150 .470 .695	.227 .173 351 .155 .446 .633	.230 .179 97 .155 .419 .651	.213 .151 47 .184 .394 .519	.223 .177 674 .144 .442 .645		50
.100 .079 647 .077 .138 .382	.139 .127 160 .092 .189 .616	.171 .088 14 .147 .244 .409		.114 .098 954 .083 .166 .447		40
.089 .040 538 .084 .123 .193	.052 .013 5 .046 .060 .072	.050 .023 12 .042 .056 .114		.082 .041 806 .076 .116 .194		30
.052 .034 8 .038 .076 .111	.029 .021 63 .020 .052 .085	.028 .011 25 .027 .036 .054		.039 .024 322 .037 .059 .109		20
.036 .012 9 .036 .043 .059	.020 .015 3 .025 .036 .036	.025 .012 29 .028 .033 .057		.023 .011 120 .019 .035 .052		10
		.021 .010 25 .021 .030 .045		.022 .009 127 .021 .031 .039		0
		.020 .013 34 .019 .031 .048		.023 .013 148 .022 .036 .052		10
				.031 .020 161 .025 .048 .078		20
				.050 .028 73 .043 .072 .108		30
						40
						50
						60
						70
						80
						90S

SPRING
FL 370

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.621 .168 44 .620 .800 .911	
40	.369 .209 61 .424 .541 .711		.520 .162 13 .618 .665 .690	.432 .276 93 .411 .732 .356	
30	.195 .165 39 .116 .447 .492		.193 .155 51 .123 .304 .596	.173 .187 48 .094 .258 .705	
20	.104 .026 2 .078 .130 .130	.075 .030 93 .077 .103 .130	.071 .030 23 .060 .100 .142	.075 .027 31 .067 .111 .122	
10		.029 .022 33 .026 .051 .086	.024 .009 26 .025 .032 .036	.063 .034 50 .057 .095 .138	
0		.041 .002 3 .041 .044 .044		.013 .005 35 .012 .017 .028	
10			.027 .007 15 .025 .034 .037	.024 .010 41 .019 .034 .069	
20		.036 .009 3 .033 .048 .048	.022 .006 3 .023 .029 .029	.045 .014 20 .044 .059 .081	
30		.083 .033 11 .097 .112 .133	.036 .008 13 .038 .043 .047	.046 .017 5 .057 .057 .063	
40		.057 .015 10 .057 .065 .082	.050 .032 4 .054 .081 .149	.069 1	
50					
60					
70					
80					
90S					

SPRING
FL 370

165W	120W			75W			30W			15E	MEAN	LAT
												90N
												80
.401 .164 19 .399 .574 .658	.597 .133 56 .625 .715 .841	.588 .078 26 .594 .633 .707	.540 .054 9 .544 .587 .598	.556 .144 119 .578 .658 .897								70
.541 .234 57 .565 .814 .475	.400 .168 43 .423 .564 .626	.343 .187 133 .309 .575 .758	.289 .181 244 .253 .490 .656	.367 .216 521 .345 .613 .852								60
.338 .233 153 .269 .635 .756	.276 .223 425 .172 .571 .791	.263 .177 163 .243 .437 .690	.322 .232 83 .316 .539 .724	.312 .230 991 .246 .594 .786								50
.144 .133 757 .096 .222 .662	.232 .191 404 .144 .461 .743	.070 .027 9 .060 .093 .133		.175 .162 1308 .109 .317 .681								40
.093 .050 721 .097 .126 .240	.040 .046 41 .027 .066 .125	.036 .005 3 .038 .041 .041		.068 .048 914 .083 .120 .237								30
.032 .024 70 .025 .048 .113	.042 .024 123 .039 .067 .096	.038 .017 32 .040 .050 .064		.040 .027 334 .034 .067 .108								20
.024 .007 14 .026 .029 .034	.013 .011 4 .015 .030 .032	.016 .012 69 .015 .029 .034		.016 .011 136 .013 .029 .039								10
		.022 .020 153 .016 .030 .061		.021 .015 154 .020 .037 .061								0
		.026 .011 75 .028 .038 .045		.030 .015 101 .029 .043 .064								10
		.024 .019 10 .027 .041 .064		.049 .031 39 .041 .064 .115								20
				.058 .030 60 .054 .076 .149								30
												40
												50
												60
												70
												80
												90S

SPRING
FL 390

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.673 .074 7 .636 .743 .805	
50				.716 .184 61 .723 .859 1.159	
40	.165 .102 20 .112 .278 .333		.283 .026 5 .275 .313 .316	.356 .302 79 .277 .730 .966	
30	.066 .014 9 .067 .082 .087		.145 .120 18 .067 .319 .383	.081 .024 7 .074 .102 .127	
20	.157 1		.046 .026 27 .036 .078 .101	.081 .015 8 .088 .093 .097	
10		.060 1	.030 .010 25 .029 .038 .056	.036 .009 8 .037 .043 .048	
0				.033 .020 6 .026 .046 .062	
10				.037 .013 7 .035 .043 .062	
20		.047 1		.041 .018 32 .036 .056 .070	
30		.056 1	.044 .003 2 .041 .047 .047	.066 .079 55 .034 .085 .309	
40			.055 .010 8 .056 .067 .076	.077 .029 51 .073 .106 .142	
50					
60					
70					
80					
90S					

SPRING
FL 390

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.550 .155 .37 .520 .767 .435						70
				.570 .152 .44 .544 .767 .835		60
.500 .235 .65 .455 .728 .977	.625 .147 .22 .511 .736 .886	.467 .143 .142 .456 .569 .845	.500 .146 .102 .500 .661 .731	.529 .191 .342 .500 .717 .979		50
.406 .202 .127 .401 .599 .765	.372 .253 .525 .322 .642 .938	.308 .201 .233 .298 .536 .686	.386 .163 .25 .375 .622 .655	.356 .240 .1014 .318 .613 .969		40
.218 .169 .314 .146 .396 .674	.262 .209 .488 .180 .473 .832	.105 .048 .8 .087 .133 .210		.238 .194 .844 .164 .433 .790		30
.128 .086 .360 .104 .205 .368	.060 .039 .89 .055 .109 .125	.033 .021 .13 .026 .039 .083		.108 .082 .498 .092 .179 .330		20
.036 .019 .37 .031 .042 .097	.040 .030 .37 .032 .064 .107	.025 .006 .7 .026 .026 .034		.035 .022 .115 .031 .046 .106		10
.033 .012 .37 .034 .042 .054		.017 .014 .52 .012 .033 .050		.024 .016 .55 .026 .040 .054		0
.039 .019 .19 .037 .055 .079		.016 .015 .48 .013 .038 .044		.024 .019 .74 .021 .042 .078		10
		.021 .012 .20 .016 .036 .045		.033 .019 .53 .033 .053 .070		20
				.065 .077 .58 .034 .085 .304		30
				.075 .028 .57 .068 .099 .142		40
						50
						60
						70
						80
						90S

SPRING
FL 410

Code:	Mean	St. Dev.	N
	50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.528 .156 5	
				.451 .516 .832	
50				.646 .218 37	
				.637 .876 1.058	
40	.258 .110 16		.516 .143 19	.652 .300 31	
	.267 .372 .445		.534 .598 .824	.693 .985 1.086	
30	.408 .260 29		.306 .221 17		
	.305 .759 .838		.297 .413 .736		
20	.206 .076 7	.109 .023 4			
	.214 .262 .325	.095 .100 .148			
10		.091 .025 7			
		.097 .110 .124			
0				.040 .008 6	
				.038 .045 .054	
10				.030 .012 32	
				.031 .039 .048	
20				.032 .008 4	
				.032 .042 .047	
30					
40				.114 .025 19	
				.115 .141 .169	
50					
60					
70					
80					
90S					

SPRING
FL 410

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
.460 .040 2 .420 .499 .499					.509 .137 7 .451 .516 .832	60
.598 .095 4 .531 .658 .720	.627 .254 17 .725 .422 .978	.480 .131 61 .478 .578 .805	.638 .256 43 .509 .939 1.136	.578 .218 162 .508 .831 1.091		50
.572 .173 24 .484 .767 1.003	.374 .202 298 .325 .587 .811	.440 .137 79 .446 .566 .708	.557 .222 67 .487 .836 1.013	.433 .219 534 .406 .651 .983		40
.443 .346 59 .383 .900 1.227	.320 .207 208 .258 .460 .780			.350 .250 313 .269 .631 .868		30
.138 .053 63 .133 .197 .256				.143 .058 74 .133 .201 .264		20
.042 .021 17 .038 .051 .108				.056 .032 24 .044 .097 .124		10
.010 .017 24 .034 .043 .064				.032 .016 30 .035 .045 .055		0
				.030 .012 32 .031 .039 .048		10
.031 .007 24 .029 .036 .054				.031 .008 33 .030 .036 .047		20
						30
				.114 .025 19 .115 .141 .169		40
						50
						60
						70
						80
						90S

SPRING
FL 430

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.594 .134 15 .563 .761 .905	
40			.666 .143 16 .740 .762 .850	.761 .122 14 .723 .889 1.009	
30			.314 .117 6 .302 .420 .482		
20					
10					
0					
10				.037 .020 7 .032 .062 .065	
20				.036 .008 10 .034 .042 .049	
30					
40				.165 .021 4 .152 .178 .190	
50					
60					
70					
80					
90S					

SPRING
FL 430

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
		.346 .050 7 .335 .342 .463		.515 .163 22 .503 .633 .905		50
.475 .011 2 .464 .486 .486	.341 .140 100 .302 .492 .630	.402 .118 27 .349 .567 .612		.423 .196 159 .391 .629 .850		40
.316 .109 28 .300 .429 .452	.319 .180 67 .305 .417 .979			.318 .159 103 .305 .429 .723		30
.168 .056 16 .157 .227 .256				.168 .056 16 .157 .227 .256		20
.026 .004 5 .025 .031 .031				.026 .004 5 .025 .031 .031		10
						0
				.037 .020 7 .032 .062 .065		10
.043 .022 30 .037 .057 .101				.041 .020 40 .036 .050 .101		20
						30
				.165 .021 4 .152 .178 .190		40
						50
						60
						70
						80
						90S

SUMMER
FL 290

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.046 .033 79 .082 .109 .152				
30	.071 .026 124 .063 .083 .144	.051 1	.052 .013 4 .051 .051 .072		
20	.068 .031 33 .061 .083 .161	.041 .015 70 .041 .058 .070	.048 .006 3 .050 .055 .055		
10		.028 .010 56 .028 .037 .053	.030 .010 4 .033 .036 .037		
0		.027 .007 57 .028 .033 .041	.013 .002 10 .012 .015 .015		
10		.034 .008 5 .037 .040 .040	.018 .003 46 .017 .020 .023		
20		.058 .019 10 .052 .073 .094	.027 .005 12 .028 .029 .040	.025 .005 11 .025 .029 .031	
30		.038 .007 5 .042 .042 .043	.055 .019 54 .053 .070 .102	.036 .010 4 .042 .045 .050	
40			.060 .027 40 .049 .084 .121	.052 .013 17 .054 .061 .078	
50					
60					
70					
80					
90S					

SUMMER
FL 290

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
			.073 .027 23 .072 .083 .170	.073 .027 23 .072 .083 .170		50
.063 .020 18 .065 .082 .100	.102 .065 13 .092 .146 .251	.084 .035 9 .105 .111 .113	.071 .020 45 .071 .087 .110	.081 .034 164 .077 .102 .163		40
.046 .036 10 .044 .089 .143	.062 .024 9 .044 .101 .109			.069 .027 148 .062 .086 .143		30
.040 .014 7 .043 .053 .060				.049 .024 113 .045 .065 .116		20
.034 .012 10 .030 .046 .050				.029 .010 70 .029 .039 .053		10
				.025 .008 67 .026 .032 .041		0
				.019 .006 51 .019 .022 .040		10
				.036 .019 33 .029 .052 .080		20
				.051 .019 68 .045 .066 .102		30
				.058 .024 57 .052 .078 .121		40
						50
						60
						70
						80
						90S

SUMMER
FL 310

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.107 .057 72 .087 .141 .288				
30	.066 .017 175 .062 .079 .109		.045 .015 24 .048 .058 .072	.045 .006 6 .043 .051 .052	
20	.058 .013 50 .055 .074 .081	.047 .018 169 .044 .064 .092	.045 .016 16 .042 .052 .095		
10		.031 .012 74 .028 .039 .068	.031 .020 2 .011 .051 .051	.027 .005 4 .028 .028 .032	
0		.028 .007 48 .026 .036 .043	.026 1	.023 .008 19 .025 .029 .035	
10		.031 .007 38 .029 .040 .044	.025 .007 53 .025 .030 .040	.030 .005 6 .026 .036 .037	
20		.039 .010 29 .038 .043 .061	.028 .006 73 .028 .034 .043	.040 .016 6 .034 .056 .073	
30	.060 1	.058 .015 5 .063 .069 .076	.048 .024 173 .040 .070 .114	.033 .011 15 .028 .039 .066	
40			.077 .054 73 .061 .097 .289	.072 .037 12 .061 .103 .151	
50					
60					
70					
80					
90S					

SUMMER
FL 310

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.167 .054 1A .178 .202 .25A		.092 .038 A .104 .127 .132	.072 .020 56 .070 .082 .110	.095 .050 82 .079 .132 .204		50
.085 .062 3 .041 .173 .173	.082 .026 28 .080 .103 .108	.096 .064 41 .080 .160 .229	.069 .013 24 .066 .081 .098	.094 .053 16H .081 .122 .255		40
.065 .039 71 .052 .099 .145	.118 .106 12 .063 .277 .286			.066 .035 288 .060 .081 .145		30
.058 .046 54 .044 .078 .181				.051 .026 289 .047 .067 .099		20
.026 .009 44 .024 .035 .046				.029 .012 129 .028 .03H .065		10
.031 .012 2 .019 .043 .043		.027 1		.026 .008 71 .026 .035 .043		0
		.030 .004 5 .032 .032 .033		.028 .007 102 .027 .035 .044		10
				.032 .010 110 .030 .038 .061		20
				.047 .023 194 .039 .069 .111		30
				.076 .052 85 .061 .103 .217		40
						50
						60
						70
						80
						90S

SUMMER
FL 330

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.080 .020 22 .080 .050 .119	
40	.096 .040 56 .085 .123 .220		.051 1	.119 .061 34 .097 .185 .249	
30	.071 .030 242 .064 .085 .153		.045 .020 36 .042 .058 .096	.046 .022 19 .037 .061 .110	
20	.049 .011 32 .046 .061 .069	.049 .015 275 .048 .065 .080	.038 .017 14 .040 .056 .060	.040 .006 10 .039 .040 .048	
10		.033 .011 126 .032 .040 .070	.024 .009 13 .019 .028 .050	.038 .011 13 .040 .050 .051	
0		.029 .010 67 .027 .037 .055	.019 .004 26 .018 .022 .028	.026 .004 7 .025 .031 .032	
10		.034 .007 43 .034 .042 .047	.021 .006 85 .021 .027 .033	.024 .005 37 .022 .030 .034	
20		.034 .007 39 .036 .039 .045	.032 .010 109 .031 .040 .054	.031 .010 39 .029 .037 .047	
30		.047 .015 11 .038 .064 .073	.064 .034 132 .060 .085 .134	.054 .032 107 .046 .080 .132	
40			.044 .052 101 .069 .110 .312	.094 .060 93 .076 .137 .260	
50				.284 .102 5 .346 .372 .380	
60					
70					
80					
90S					

SUMMER
FL 330

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.128 .022 7 .130 .137 .166	.129 .024 4 .113 .139 .163		.161 .134 24 .121 .211 .568	.123 .096 57 .097 .144 .554		50
.043 .015 7 .034 .054 .071	.125 .123 20 .070 .253 .406	.078 .028 34 .079 .105 .120	.078 .015 38 .076 .092 .114	.094 .057 194 .078 .120 .253		40
.079 .058 83 .059 .117 .239	.126 .106 14 .075 .187 .407			.071 .044 394 .061 .089 .231		30
.049 .066 111 .053 .083 .319	.058 .024 10 .046 .072 .103			.053 .037 452 .047 .067 .127		20
.030 .010 14 .028 .037 .046				.033 .011 166 .031 .042 .070		10
.014 1				.026 .010 161 .023 .034 .051		0
				.025 .008 165 .023 .034 .045		10
.042 .010 14 .044 .051 .053				.032 .010 201 .032 .041 .054		20
				.059 .033 250 .053 .080 .134		30
				.089 .055 194 .070 .121 .282		40
				.266 .102 5 .346 .372 .380		50
						60
						70
						80
						90S

SUMMER
FL 350

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.157 .033 4 .140 .165 .207	
50				.217 .113 19 .156 .371 .414	
40	.138 .074 119 .109 .208 .315		.083 .055 15 .064 .139 .247	.081 .051 104 .061 .123 .252	
30	.071 .052 288 .059 .087 .254		.047 .018 47 .043 .057 .071	.105 .104 29 .049 .247 .314	
20	.046 .011 62 .043 .057 .072	.045 .020 79 .041 .061 .094	.028 .013 5 .024 .028 .053	.027 .008 29 .026 .034 .037	
10		.032 .010 92 .031 .038 .060	.021 .006 32 .022 .026 .032		
0		.025 .010 98 .025 .033 .047	.022 .007 38 .021 .028 .034	.021 .007 52 .022 .025 .038	
10		.026 .007 67 .025 .032 .043	.023 .009 147 .021 .030 .039	.022 .006 123 .022 .027 .032	
20		.030 .007 54 .029 .036 .050	.032 .013 154 .029 .043 .068	.028 .009 97 .026 .033 .051	
30	.071 .018 15 .068 .089 .112	.036 .007 14 .036 .041 .053	.058 .035 148 .049 .078 .145	.060 .042 134 .048 .088 .194	
40			.107 .073 165 .082 .160 .308	.117 .056 117 .111 .170 .230	
50				.188 .073 6 .144 .266 .310	
60					
70					
80					
90S					

SUMMER
FL 350

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
.321 .135 .42 .345 .449 .553	.282 .166 .57 .291 .482 .531			.293 .154 .103 .322 .452 .524		70
.175 .105 .19 .169 .282 .319	.265 .147 .115 .267 .451 .521	.111 .074 .50 .071 .196 .283	.143 .093 .147 .098 .247 .379	.184 .128 .350 .126 .320 .501		60
.078 .057 .81 .060 .119 .236	.128 .130 .220 .077 .219 .522	.096 .041 .100 .086 .111 .235	.141 .085 .66 .105 .211 .368	.113 .092 .705 .083 .164 .443		50
.075 .046 .291 .057 .099 .332	.103 .069 .38 .085 .133 .295	.053 1		.074 .062 .694 .057 .094 .316		40
.053 .032 .309 .044 .080 .174	.072 1			.049 .028 .485 .042 .064 .136		30
.030 .014 .38 .027 .036 .059		.026 1		.030 .011 .163 .028 .037 .060		20
.025 .013 .58 .020 .039 .058		.026 .006 .11 .026 .032 .044		.024 .010 .257 .023 .032 .055		10
				.023 .008 .337 .022 .029 .040		0
.032 .004 .12 .032 .034 .040				.030 .011 .327 .022 .039 .065		10
				.058 .037 .311 .045 .020 .174		20
				.111 .066 .252 .094 .166 .272		30
				.188 .073 .6 .144 .266 .310		40
						50
						60
						70
						80
						90S

SUMMER
FL 370

Code:

Mean	St. Dev.	N
507	847	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.136 .092 11 .072 .230 .227	
50				.260 .139 132 .251 .399 .536	
40	.129 .065 35 .116 .208 .253		.095 .070 14 .065 .157 .254	.231 .172 352 .175 .428 .526	
30	.068 .059 39 .054 .079 .259		.067 .047 80 .054 .100 .193	.074 .073 77 .051 .110 .312	
20	.055 .011 2 .044 .066 .066	.038 .013 29 .036 .046 .062	.053 .018 11 .054 .062 .083	.040 .015 20 .036 .060 .072	
10		.027 .009 54 .026 .037 .044	.027 .008 22 .027 .033 .050		
0		.027 .006 40 .026 .031 .042	.019 .006 3 .017 .027 .027	.020 .009 78 .019 .025 .037	
10			.017 .001 5 .017 .019 .019	.022 .007 46 .023 .029 .036	
20		.034 .003 2 .031 .036 .036	.023 .008 12 .019 .031 .036	.027 .008 55 .025 .034 .048	
30		.042 1	.063 .071 52 .043 .077 .346	.028 .021 44 .023 .046 .072	
40		.051 .003 7 .050 .054 .057	.147 .095 135 .120 .227 .433	.164 .078 23 .134 .275 .335	
50					
60					
70					
80					
90S					

SUMMER
FL 370

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
		.550 .041 4 .530 .558 .610	.557 .005 6 .555 .562 .564	.554 .026 10 .555 .562 .610		70
.186 .122 35 .232 .315 .355	.469 .172 47 .565 .644 .667	.479 .160 35 .538 .631 .661	.341 .198 52 .324 .557 .603	.359 .206 180 .329 .513 .665		60
.279 .148 196 .280 .445 .525	.276 .157 197 .268 .452 .553	.328 .185 56 .382 .514 .555	.235 .160 116 .187 .414 .563	.271 .156 697 .251 .450 .553		50
.183 .154 259 .101 .393 .420	.167 .113 163 .124 .288 .459	.155 .130 114 .099 .287 .525	.148 .044 23 .148 .177 .285	.190 .151 960 .124 .390 .506		40
.074 .068 328 .053 .102 .269	.131 .090 107 .102 .216 .376			.002 .074 631 .058 .119 .334		30
.059 .057 384 .050 .073 .133	.046 .005 4 .042 .049 .052			.057 .053 450 .049 .071 .121		20
.028 .015 94 .024 .040 .060	.035 .011 8 .037 .047 .050	.029 .007 4 .024 .030 .039		.028 .012 187 .026 .037 .055		10
.021 .007 57 .021 .027 .033				.022 .008 178 .022 .028 .048		0
				.022 .007 101 .022 .024 .036		10
				.026 .004 69 .025 .034 .048		20
				.047 .057 76 .036 .060 .249		30
				.147 .043 240 .123 .236 .404		40
						50
						60
						70
						80
						90S

SUMMER
FL 390

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.398 .114 36 .430 .511 .529	
50				.315 .136 175 .334 .463 .554	
40	.213 .088 8 .167 .336 .350			.159 .145 177 .078 .329 .505	
30			.064 .066 27 .044 .084 .116	.069 .046 67 .054 .108 .194	
20				.041 .027 24 .034 .048 .149	
10		.016 .009 9 .017 .025 .030	.032 .005 9 .032 .038 .039		
0		.019 .007 13 .022 .023 .025	.024 .002 5 .025 .025 .027	.024 .012 3 .018 .041 .041	
10				.023 .004 6 .021 .026 .030	
20	.033 1	.034 .004 7 .032 .036 .042	.017 .002 10 .018 .018 .021	.029 .007 10 .027 .035 .040	
30			.022 .002 14 .023 .024 .026	.038 .002 3 .039 .040 .040	
40			.114 .034 27 .123 .151 .171	.197 .110 55 .171 .291 .529	
50					
60					
70					
80					
90S					

SUMMER
FL 390

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.514 .097 15 .553 .601 .631	.474 .150 31 .500 .629 .671		.487 .136 46 .532 .619 .671		70
.356 .172 264 .370 .529 .613	.531 .106 198 .546 .637 .696	.558 .092 222 .579 .645 .684	.415 .152 89 .431 .577 .606	.463 .160 811 .512 .613 .679		60
.331 .148 183 .326 .494 .604	.469 .146 138 .489 .622 .650	.343 .158 121 .351 .497 .662	.308 .136 273 .313 .451 .595	.344 .153 890 .346 .508 .636		50
.216 .141 86 .194 .369 .514	.216 .152 123 .134 .783 .586	.160 .106 149 .112 .255 .471	.275 .118 47 .271 .403 .492	.189 .139 590 .132 .352 .518		40
.089 .095 122 .059 .095 .456	.120 .075 103 .101 .167 .348	.108 .024 10 .105 .132 .144		.092 .078 349 .071 .135 .371		30
.040 .084 110 .052 .100 .393	.348 .011 14 .050 .758 .062	.078 1		.070 .075 149 .048 .092 .391		20
.032 .015 47 .031 .051 .059	.015 .006 5 .016 .017 .024			.029 .015 70 .029 .044 .059		10
.028 .019 29 .027 .044 .064				.025 .016 50 .023 .041 .064		0
.024 .005 16 .030 .032 .038				.028 .005 24 .028 .032 .038		10
				.026 .008 34 .025 .035 .040		20
				.025 .007 17 .023 .026 .040		30
				.167 .100 82 .141 .244 .421		40
						50
						60
						70
						80
						90S

SUMMER
FL 410

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.478 .093 6 .534 .543 .545	
50				.341 .145 157 .377 .488 .548	
40	.223 .140 25 .190 .367 .532		.134 .099 32 .096 .257 .320	.201 .119 137 .199 .322 .477	
30	.084 .042 30 .081 .092 .167		.061 .025 44 .056 .088 .098	.051	1
20	.054 .005 4 .050 .053 .062				
10		.021 .006 15 .022 .027 .034			
0					
10				.025	1
20				.028 .003 12 .026 .030 .034	
30				.066 .042 20 .048 .084 .215	
40				.229 .129 15 .157 .363 .443	
50					
60					
70					
80					
90S					

SUMMER
FL 410

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.504 .072 6 .509 .564 .572	.474 .114 3 .554 .554 .554		.494 .089 9 .531 .564 .572		70
.292 .131 12 .332 .414 .440	.508 .131 45 .499 .453 .728	.497 .182 127 .527 .690 .742	.405 .152 73 .424 .590 .640	.464 .172 263 .463 .653 .731		60
.199 .015 2 .184 .214 .214	.383 .161 160 .409 .541 .675	.385 .144 139 .393 .562 .614	.412 .128 220 .411 .548 .644	.382 .146 680 .396 .531 .633		50
.215 .140 225 .180 .388 .521	.279 .146 388 .271 .421 .587	.196 .123 76 .154 .314 .492	.236 .152 32 .155 .445 .488	.237 .143 915 .209 .399 .550		40
.157 .145 110 .105 .254 .556	.047 .025 13 .037 .066 .100			.117 .119 198 .080 .151 .514		30
.035 .011 24 .031 .041 .056				.037 .012 33 .033 .050 .062		20
				.021 .006 15 .022 .027 .034		10
						0
				.025 1		10
				.028 .003 12 .026 .030 .034		20
				.066 .042 20 .048 .084 .215		30
				.229 .128 15 .157 .363 .443		40
						50
						60
						70
						80
						90S

SUMMER
FL 430

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.386 .444	.120 .488 67 .509
40			.127 .108 72 .090 .151 .52H	.194 .126 126 .139 .335 .453	
30			.104 .102 77 .076 .113 .414	.085 .013 10 .079 .098 .100	
20					
10					
0					
10					
20					
30					
40				.209 .025 7 .202 .242 .246	
50					
60					
70					
80					
90S					

SUMMER
FL 430

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
	.637 .113 8 .643 .718 .795	.643 .004 2 .638 .647 .647		.638 .101 10 .643 .703 .795		70
.441 .159 5 .408 .597 .620	.468 .181 34 .490 .654 .736	.265 .057 19 .269 .319 .335	.277 .070 8 .225 .380 .407	.385 .149 133 .411 .506 .684		60
.744 .099 13 .368 .380 .588	.154 .077 44 .136 .236 .316	.270 .107 56 .264 .343 .510		.193 .125 311 .145 .330 .505		50
.137 .036 12 .131 .147 .219				.106 .092 94 .078 .138 .414		40
.094 .009 3 .088 .106 .106				.094 .009 3 .088 .106 .106		30
						20
						10
						0
						10
						20
						30
				.209 .025 7 .202 .242 .246		40
						50
						60
						70
						80
						90S

AUTUMN
FL 290

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.076 .016 10 .066 .094 .100				
30	.038 .010 2 .028 .047 .047		.049 .019 5 .048 .067 .073		
20	.061 .016 6 .062 .075 .077	.054 .017 19 .053 .072 .079	.019 1		
10		.033 .006 6 .030 .041 .042	.033 .008 2 .024 .041 .041	.012 1	
0		.034 .005 4 .030 .035 .041			
10			.025 .009 18 .023 .027 .051		
20			.021 .002 4 .020 .023 .023	.033 .025 8 .024 .061 .073	
30		.080 1	.087 .009 8 .083 .097 .105	.040 .028 16 .027 .070 .086	
40			.078 .038 13 .066 .098 .179	.073 .049 18 .062 .099 .241	
50					
60					
70			.017 1		
80					
90S					

AUTUMN
FL 290

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
			.086 .069 19 .055 .098 .337	.086 .069 19 .059 .094 .337		50
	.045 .029 10 .029 .052 .124	.045 .011 25 .045 .050 .077	.061 .033 25 .043 .100 .160	.055 .027 70 .045 .089 .124		40
.036 .012 20 .036 .049 .072	.057 .034 5 .055 .075 .104	.034 1		.043 .019 33 .037 .056 .075		30
.028 .014 20 .031 .041 .054				.043 .021 46 .040 .069 .077		20
.025 .013 13 .031 .041 .041	.029 .002 3 .030 .032 .032			.028 .011 27 .030 .041 .041		10
	.041 1			.035 .005 5 .035 .041 .041		0
				.025 .009 18 .023 .027 .051		10
				.029 .021 12 .023 .054 .073		20
		.077 1		.057 .031 26 .070 .084 .097		30
				.075 .045 31 .066 .099 .179		40
						50
						60
				.017 1		70
						80
						90S

AUTUMN
FL 310

Code:

Mean	St. Dev.	N
50%	84%	987

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50					
40	.082 .045 15 .057 .129 .195				
30	.055 .020 29 .049 .067 .097		.058 .023 25 .055 .067 .119	.110 .019 6 .098 .133 .134	
20	.049 .011 14 .047 .057 .073	.042 .022 8 .028 .075 .083	.052 .002 2 .050 .054 .054		
10		.045 .034 25 .031 .059 .193	.019 .015 4 .013 .019 .041	.011 .005 7 .014 .014 .014	
0		.032 .007 10 .032 .037 .044		.012 .008 41 .012 .016 .024	
10			.062 1	.012 .005 21 .010 .021 .022	
20			.057 .023 4 .056 .068 .083	.038 .041 14 .023 .069 .123	
30			.071 .030 40 .080 .100 .111	.060 .024 24 .063 .078 .128	
40	.028 .000 2 .028 .028 .028		.074 .024 36 .076 .094 .116	.068 .025 19 .053 .101 .106	
50				.044 .017 11 .039 .059 .079	
60				.037 .008 5 .038 .040 .047	
70					
80					
90S					

AUTUMN
FL 310

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.061 .030 12 .044 .075 .144		.113 .063 38 .090 .199 .211	.073 .038 77 .058 .103 .152	.083 .050 127 .051 .135 .210		50
.079 .057 15 .051 .130 .214	.061 .049 30 .046 .089 .184	.070 .030 43 .056 .099 .144	.048 .005 13 .048 .054 .057	.068 .042 116 .053 .097 .203		40
.036 .016 37 .031 .050 .068	.036 .018 10 .028 .051 .066			.050 .026 107 .045 .067 .122		30
.030 .012 27 .027 .044 .048				.038 .016 51 .038 .050 .075		20
.018 .012 40 .015 .028 .048	.044 1			.027 .025 77 .019 .041 .065		10
.017 .008 11 .015 .022 .032		.035 1		.017 .010 63 .013 .028 .044		0
				.014 .011 22 .010 .021 .062		10
				.043 .038 18 .027 .083 .123		20
		.053 1		.067 .029 65 .070 .094 .116		30
				.070 .026 57 .070 .097 .116		40
				.044 .017 11 .039 .059 .079		50
				.037 .008 5 .038 .040 .047		60
						70
						80
						90S

AUTUMN
FL 330

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.105 .052 19 .085 .180 .231	
40	.092 .046 8 .106 .120 .172		.069 .030 9 .055 .123 .126	.110 .030 26 .102 .133 .166	
30	.065 .027 76 .058 .083 .124		.063 .024 31 .054 .083 .107	.109	1
20	.061 .014 14 .064 .074 .087	.049 .013 27 .051 .055 .066	.042	1	
10		.031 .011 45 .030 .019 .043	.024 .013 14 .027 .045 .053		
0		.025 .005 37 .026 .029 .036	.011 .008 20 .013 .021 .024	.035	1
10		.027 .003 14 .027 .030 .032	.024 .014 55 .024 .041 .057	.026 .020 65 .023 .037 .079	
20		.049 .014 16 .044 .057 .083	.043 .029 55 .032 .077 .101	.019 .011 41 .019 .037 .041	
30		.058 .010 4 .052 .055 .075	.075 .024 62 .077 .045 .122	.072 .044 82 .064 .109 .226	
40	.036 .005 4 .032 .038 .042		.131 .067 12 .113 .157 .326	.100 .070 54 .080 .124 .274	
50				.061 .026 7 .071 .077 .083	
60				.052 .028 15 .045 .087 .121	
70				.044 .033 8 .026 .086 .113	
80					
90S					

AUTUMN
FL 330

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
						60
.121 .063 20 .118 .187 .235	.153 .047 6 .128 .188 .232	.094 .068 83 .060 .192 .217	.093 .057 117 .064 .162 .243	.100 .062 245 .068 .186 .231		50
.152 .068 9 .094 .229 .237	.064 .037 34 .054 .105 .137	.062 .043 159 .051 .073 .217	.073 .041 43 .052 .116 .162	.072 .047 288 .054 .118 .220		40
.053 .023 53 .052 .073 .112	.078 .027 9 .074 .094 .139	.122 .079 3 .066 .234 .234		.063 .029 173 .058 .082 .139		30
.044 .038 59 .041 .068 .186	.048 .014 15 .053 .059 .067			.048 .029 116 .046 .066 .126		20
	.065 .004 8 .065 .070 .071	.039 .007 8 .037 .040 .054		.035 .015 75 .032 .045 .071		10
.039 .004 5 .034 .042 .045		.036 .004 4 .037 .038 .039		.023 .011 67 .024 .030 .042		0
.046 .018 16 .043 .057 .091				.029 .017 155 .027 .041 .077		10
		.055 1		.036 .025 113 .029 .055 .101		20
				.073 .040 148 .074 .100 .177		30
				.102 .070 75 .080 .135 .326		40
				.061 .026 7 .071 .077 .083		50
				.052 .028 15 .045 .087 .121		60
				.045 .033 6 .026 .086 .113		70
						80
						90S

AUTUMN
FL 350

Code: Mean St. Dev. N
50% 84% 98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60					
50				.239 .086 54 .242 .136 .385	
40	.085 .036 61 .079 .112 .182		.066 .019 14 .069 .084 .096	.118 .100 93 .068 .232 .343	
30	.069 .028 68 .060 .097 .137		.083 .054 53 .055 .143 .203	.136 .059 6 .127 .292 .219	
20	.072 .023 12 .083 .095 .097	.053 .018 52 .047 .074 .094	.047 .020 23 .051 .058 .097		
10		.034 .012 44 .032 .042 .069	.039 .016 25 .040 .054 .068		
0		.025 .005 23 .027 .029 .033	.018 .009 31 .015 .022 .035	.020 .008 36 .018 .027 .039	
10		.032 .004 7 .032 .035 .038	.030 .024 62 .025 .056 .084	.020 .010 59 .018 .036 .038	
20		.046 .025 12 .029 .085 .086	.042 .027 66 .037 .070 .096	.020 .017 77 .017 .237 .054	
30		.080 .006 4 .074 .083 .088	.062 .037 70 .059 .101 .138	.079 .069 118 .094 .136 .303	
40	.052 .006 12 .054 .056 .060		.098 .064 49 .081 .127 .296	.103 .075 104 .080 .125 .357	
50	.055 .023 61 .049 .060 .129		.069 .016 10 .047 .068 .115	.082 1	
60	.205 .083 50 .151 .307 .368		.035 .000 2 .034 .035 .035	.072 .037 5 .053 .060 .145	
70	.391 1		.045 .006 4 .040 .043 .055	.091 .002 3 .090 .094 .094	
80					
90S					

AUTUMN
FL 350

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
						70
.219 .061 22 .221 .263 .311	.151 .067 41 .140 .223 .280	.286 .017 2 .264 .302 .302	.229 .133 17 .231 .301 .308	.189 .092 82 .195 .277 .302		60
.223 .089 30 .209 .322 .338	.151 .091 288 .130 .258 .317	.101 .067 203 .065 .177 .259	.100 .057 256 .079 .155 .225	.131 .086 831 .165 .233 .336		50
.131 .081 100 .121 .212 .322	.107 .085 300 .067 .220 .311	.083 .061 171 .060 .133 .242	.070 .029 39 .066 .104 .132	.102 .078 760 .066 .195 .326		40
.053 .026 214 .048 .075 .122	.058 .065 41 .031 .080 .284	.058 1	.054 .021 35 .051 .082 .115	.060 .039 438 .050 .086 .183		30
.033 .019 210 .031 .052 .074	.053 .001 5 .053 .054 .055		.055 .007 52 .052 .081 .071	.042 .021 354 .042 .050 .094		20
.022 .004 44 .019 .030 .052	.049 .010 25 .047 .058 .072			.034 .015 138 .032 .051 .068		10
.014 .003 3 .012 .018 .018				.021 .008 93 .018 .029 .039		0
		.043 .005 9 .042 .050 .051		.027 .019 137 .022 .043 .072		10
		.051 .002 12 .050 .053 .055		.033 .025 167 .028 .054 .091		20
		.100 1		.085 .061 193 .080 .121 .274		30
				.094 .070 165 .075 .125 .353		40
				.057 .022 72 .050 .068 .129		50
				.187 .092 57 .147 .299 .356		60
				.105 .116 8 .055 .094 .391		70
						80
						90S

AUTUMN
FL 370

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.167 .022 4	
				.174 .180 .185	
50				.215 .104 175	
				.234 .324 .385	
40	.116 .075 13		.079 .066 33	.098 .074 401	
	.690 .219 .253		.051 .184 .213	.073 .151 .327	
30	.122 .045 27		.063 .055 123	.046 .059 50	
	.110 .175 .197		.047 .097 .262	.069 .136 .232	
20	.095 .025 6	.102 .008 4		.074 .020 11	
	.076 .122 .123	.095 .102 .115		.069 .095 .104	
10		.037 .020 16	.022 1		
		.034 .040 .094			
0		.015 .022 10	.002 1	.020 .008 76	
		.001 .035 .060		.020 .027 .032	
10				.023 .007 57	
				.021 .028 .040	
20			.041 .019 10	.023 .015 91	
			.030 .055 .073	.016 .029 .077	
30			.051 .045 33	.071 .053 110	
			.028 .098 .122	.067 .131 .173	
40			.209 .111 66	.121 .051 40	
			.175 .315 .443	.103 .150 .301	
50			.126 .050 13	.240 .055 15	
			.140 .166 .197	.262 .343 .393	
60			.169 .019 7	.104 .053 22	
			.172 .182 .191	.087 .107 .271	
70	.402 .027 50			.602 .015 10	
	.399 .430 .447			.675 .097 .107	
80	.321 .175 34				
	.322 .342 .390				
90S	.254 .020 14				
	.253 .279 .292				

AUTUMN
FL 370

165W	120W	75W	30W	15E	MEAN	LAT
.280 .015 4 .283 .291 .292				.280 .015 4 .283 .291 .292		90N
.298 .035 50 .305 .329 .358				.298 .035 50 .305 .329 .358		80
.253 .083 192 .262 .317 .401	.228 .098 86 .253 .320 .381	.322 1		.244 .088 283 .260 .320 .399		70
.218 .073 122 .232 .280 .360	.208 .117 104 .215 .310 .499	.125 .095 118 .101 .205 .376	.127 .072 190 .118 .201 .298	.176 .102 709 .166 .289 .374		60
.135 .095 121 .118 .233 .391	.098 .073 192 .074 .158 .310	.100 .075 257 .071 .175 .324	.100 .042 71 .118 .134 .143	.102 .076 1088 .076 .166 .328		50
.042 .036 464 .056 .095 .154	.081 .065 106 .063 .126 .229	.052 .061 24 .034 .042 .321	.148 .009 21 .150 .158 .165	.070 .050 815 .057 .109 .222		40
.041 .028 330 .033 .069 .116	.043 1	.032 .007 29 .031 .037 .047	.049 .002 2 .047 .051 .051	.042 .028 383 .034 .072 .116		30
.017 .010 74 .016 .022 .051	.056 .005 3 .057 .062 .062	.047 .020 27 .048 .064 .092		.027 .020 121 .021 .049 .092		20
.027 .012 33 .021 .043 .048		.058 .017 25 .056 .084 .089		.028 .019 145 .022 .048 .084		10
.041 .006 8 .029 .037 .041		.056 .007 10 .058 .061 .065		.028 .014 75 .023 .039 .062		0
		.047 .006 14 .044 .052 .057		.028 .017 115 .022 .044 .077		10
		.048 .021 5 .041 .058 .083		.066 .051 148 .058 .113 .173		20
				.176 .104 106 .146 .271 .431		30
				.208 .094 28 .197 .292 .385		40
				.120 .054 29 .091 .179 .229		50
				.344 .122 60 .397 .423 .447		60
				.321 .055 54 .327 .382 .390		70
				.258 .020 16 .253 .279 .292		80
						90S

AUTUMN
FL 390

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N					
80					
70					
60				.367 .088 65	
				.381 .465 .521	
50				.298 .115 276	
				.315 .417 .495	
40	.147 .079 31			.146 .093 263	
	.111 .255 .299			.121 .236 .374	
30			.047 .024 18	.076 .030 55	
			.036 .076 .097	.069 .098 .147	
20			.057 .023 13		
			.068 .083 .083		
10		.036 .012 5	.034 .013 21		
		.039 .043 .050	.029 .048 .061		
0		.031 .011 6	.026 .008 16		
		.034 .035 .043	.022 .031 .043		
10				.017 .003 14	
				.015 .021 .024	
20				.033 .022 49	
				.023 .044 .096	
30				.057 .031 13	
				.071 .082 .094	
40	.151 1		.135 .066 31	.187 .100 43	
			.097 .208 .259	.148 .324 .382	
50			.173 .057 3	.228 .018 4	
			.212 .224 .224	.217 .232 .255	
60				.192 .019 2	
				.174 .210 .210	
70					
80				.375 .049 27	
				.357 .439 .465	
90S	.342 .032 37			.379 .040 5	
	.358 .374 .399			.378 .418 .440	

AD-A097 573

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CLEVEL--ETC F/G 4/1

TABULATIONS OF AMBIENT OZONE DATA OBTAINED BY

GAEP AIRLINERS; N--ETC (11)

SEP 80 S D NASTROM, J D HOLDEMAN

DOT-FA78WAI-893

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FAA/EE-80-83

NL

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AUTUMN
FL 390

105W	120W	75W	30W	15E	MEAN	LAT
						90N
.344 .029 40 .345 .427 .447				.394 .024 40 .395 .427 .447		80
						70
.303 .105 322 .321 .365 .542	.288 .097 21 .279 .404 .523	.405 .068 16 .420 .451 .484	.351 .073 37 .364 .421 .477	.318 .103 461 .329 .412 .525		60
.280 .154 310 .325 .478 .460	.259 .042 59 .245 .367 .410	.244 .119 141 .264 .377 .434	.233 .089 222 .233 .360 .397	.269 .109 1008 .275 .380 .454		50
.167 .105 247 .145 .303 .401	.157 .107 142 .130 .253 .439	.131 .092 199 .103 .234 .354	.215 .141 9 .129 .420 .475	.151 .100 841 .124 .255 .344		40
.072 .022 69 .007 .057 .120	.087 .073 165 .061 .130 .379	.196 1		.080 .057 308 .065 .104 .235		30
.084 .020 68 .007 .080 .137	.056 .016 9 .062 .071 .074	.028 .001 5 .028 .029 .024	.046 .001 4 .046 .047 .048	.063 .022 97 .064 .079 .147		20
.010 .024 21 .024 .073 .044		.047 .013 25 .042 .065 .076	.049 .002 45 .049 .051 .052	.043 .015 117 .047 .051 .078		10
.045 .012 30 .038 .048 .049		.064 .019 44 .058 .079 .098	.050 .007 62 .052 .058 .061	.044 .017 152 .046 .060 .093		0
.024 .012 82 .016 .042 .049		.061 .020 47 .063 .080 .093	.047 .005 47 .048 .050 .053	.039 .021 190 .040 .053 .085		10
		.053 .012 42 .055 .064 .072	.047 .001 2 .046 .048 .048	.042 .021 93 .042 .060 .093		20
				.057 .031 12 .071 .062 .054		30
				.105 .091 75 .134 .248 .386		40
				.206 .047 7 .217 .232 .255		50
				.142 .016 6 .174 .010 .210		60
						70
				.305 .000 26 .357 .434 .465		80
				.354 .000 94 .365 .465 .437		90S

AUTUMN
FL 410

Code:

Mean	St. Dev.	N
50%	84%	98%

LAT	15E	60E	105E	150E	165W
90N	.399 .008 3 .405 .405 .405				
80					
70					
60				.451 .095 18 .424 .538 .653	
50				.323 .124 363 .329 .448 .573	
40			.167 .098 67 .151 .258 .435	.204 .127 389 .186 .326 .551	
30			.093 .052 85 .077 .141 .209	.070 .039 45 .065 .100 .139	
20					
10				.020	1
0				.020 .002 4 .018 .021 .022	
10				.031 .000 2 .031 .031 .031	
20				.054 .039 16 .033 .103 .151	
30				.099 .046 24 .105 .130 .210	
40	.138 1			.212 .122 46 .168 .337 .480	
50				.571 .023 15 .568 .599 .625	
60				.839 .105 47 .876 .901 .938	
70				.547 .059 49 .528 .658 .741	
80				.410 .517 25 .413 .423 .442	
90S					

AUTUMN
FL 410

165W	120W			75W			30W			15E	MEAN	1A1
												50N
				.363	.034	12			.413	.029	57	
				.364	.199	.423			.416	.434	.477	60
									.491	.057	41	70
									.846	.567	.582	80
.320	.147	58		.293	.109	22	.389	.040	4	.385	.106	61
.329	.471	.548		.259	.388	.568	.371	.375	.457	.374	.324	.621
.265	.173	86		.284	.115	158	.254	.124	237	.265	.109	192
.211	.441	.406		.253	.386	.573	.246	.406	.554	.257	.362	.452
.160	.100	279		.190	.118	298	.224	.122	176	.201	.106	28
.112	.246	.476		.155	.304	.505	.196	.362	.444	.186	.123	.442
.042	.047	141		.086	.045	41						
.085	.146	.179		.055	.126	.172				.067	.049	312
										.076	.137	.211
.061	.025	169					.035	.012	7			
.040	.086	.127					.039	.053	.057	.054	.028	148
										.057	.077	.123
.044	.014	96					.082	.026	14			
.028	.049	.065					.084	.104	.129	.039	.023	112
										.035	.054	.104
.022	.069	68					.069	.019	11			
.020	.024	.050					.063	.075	.106	.029	.019	83
										.021	.045	.065
.027	.069	13					.079	.018	35			
.025	.034	.066					.069	.089	.102	.058	.045	50
										.061	.162	.102
							.056	.014	35	.062	.015	2
							.052	.071	.091	.067	.077	.077
							.076	.016	7			
							.080	.084	.106			
										.094	.063	57
										.092	.136	.176
										.210	.121	47
										.162	.320	.476
										.571	.023	15
										.569	.599	.625
										.839	.106	67
										.877	.901	.923
										.547	.096	49
										.528	.558	.741
										.511	.017	61
										.413	.423	.442

AUTUMN
FL 430

Code:

Mean	St. Dev.	N
50%	84%	98%

1AT	15E	60E	105E	150E	165W
90N					
80					
70				.291	1
60				.436 .160 7 .405 .552 .675	
50			.219 .164 104 .171 .365 .637	.317 .211 99 .315 .429 .866	
40			.117 .097 105 .088 .190 .422	.052 .023 31 .056 .076 .085	
30					
20					
10					
0					
10					
20	.082 .001 6 .083 .083 .083			.086 .016 4 .077 .086 .111	
30	.098 .011 14 .096 .112 .123			.409 .122 30 .464 .506 .550	
40				.350 .169 33 .298 .463 .774	
50					
60					
70					
80					
90S					

AUTUMN
FL 430

165W	120W	75W	30W	15E	MEAN	LAT
						90N
						80
					.291	70
					1	60
	.304 .116 21 .327 .291 .543	.380 .149 67 .385 .492 .741	.361 .041 45 .364 .395 .428	.365 .123 136 .365 .465 .675		50
.189 .075 50 .172 .263 .350	.222 .143 155 .157 .278 .588	.239 .134 86 .172 .394 .502		.240 .162 494 .182 .402 .637		40
.112 .068 37 .094 .113 .325	.084 .017 18 .076 .097 .125	.093 .087 39 .079 .138 .285		.101 .083 230 .060 .138 .326		30
		.046 .014 28 .046 .063 .068		.046 .014 28 .046 .063 .065		20
		.047 .008 6 .049 .053 .054		.047 .008 6 .049 .053 .054		10
						0
						10
			.072 .016 46 .081 .008 .089	.072 .016 46 .081 .008 .089		20
			.047 .012 38 .063 .084 .090	.071 .014 48 .064 .084 .090		30
				.310 .177 44 .347 .502 .550		40
				.350 .164 33 .298 .463 .774		50
						60
						70
						80
						90S

APPENDIX C

TABULATIONS OF GASP AMBIENT OZONE DATA WITH RESPECT TO THE TROPOPAUSE

TABLE C-1. - GASP OZONE DATA (PPMV) WITH RESPECT TO DISTANCE
FROM THE TROPOPAUSE DURING WINTER.

Code:

Mean	St. Dev.	N
59	84	98

more than 5000 ft below tropopause	0-5000 ft below tropopause	0-5000 ft above tropopause	5000-10000 ft above tropopause	more than 10000 ft above tropopause
		.284 .060 4 .306 .308 .337	.325 .047 5 .316 .339 .402	
	.155 .040 15 .141 .196 .241	.220 .089 94 .222 .297 .426	.326 .143 102 .306 .484 .645	.390 .167 14 .271 .580 .659
.037 .018 75 .031 .054 .082	.093 .086 207 .060 .101 .340	.234 .141 281 .201 .365 .592	.395 .241 219 .364 .585 1.047	.532 .218 64 .492 .791 1.061
.043 .028 219 .039 .064 .111	.089 .078 512 .065 .141 .310	.212 .125 639 .181 .337 .533	.303 .175 242 .275 .497 .705	.478 .274 125 .457 .799 1.040
.053 .032 737 .046 .076 .142	.079 .056 939 .064 .122 .236	.192 .114 510 .169 .289 .564	.299 .179 148 .254 .487 .742	.330 .237 58 .275 .589 .871
.051 .033 1309 .044 .080 .134	.097 .056 245 .084 .166 .219	.143 .068 52 .128 .216 .290		
.055 .023 604 .032 .056 .082	.023 .039 22 .008 .014 .133			
.040 .015 421 .028 .040 .074				
.027 .011 389 .027 .037 .051				
.038 .019 459 .035 .057 .088				
.064 .030 402 .060 .094 .130	.137 .014 9 .129 .159 .161			
.087 .049 379 .074 .114 .245	.167 .089 69 .136 .257 .378	.242 .064 27 .247 .308 .330	.342 .078 6 .305 .432 .465	

TABLE C-2. - GASP OZONE DATA (PPMV) WITH RESPECT TO DISTANCE
FROM THE TROPOPAUSE DURING SPRING.

Code:

Mean	St. Dev.	N
50%	847	987

	more than 5000 ft below tropopause	0-5000 ft below tropopause	0-5000 ft above tropopause	5000-10000 ft above tropopause	more than 10000 ft above tropopause
12M					
90S					
80		.436 .065 13 .462 .487 .503	.441 .066 11 .425 .507 .557	.679 .056 5 .641 .601 .695	
70		.203 .096 46 .217 .292 .399	.481 .152 128 .509 .610 .767	.603 .151 93 .631 .743 .836	.499 .123 9 .451 .516 .832
60	.069 .027 184 .064 .085 .147	.153 .119 598 .102 .261 .501	.376 .181 656 .370 .578 .731	.536 .170 370 .527 .706 .873	.634 .198 137 .637 .822 1.004
50	.074 .050 762 .064 .094 .254	.163 .131 1474 .114 .282 .531	.377 .179 1239 .366 .576 .751	.523 .198 583 .507 .731 .940	.580 .217 149 .558 .793 1.058
40	.075 .043 1481 .068 .100 .200	.139 .103 1955 .106 .213 .458	.323 .179 750 .287 .525 .717	.488 .204 185 .473 .717 .842	.701 .258 43 .702 .979 1.227
30	.077 .049 2668 .067 .110 .198	.114 .067 450 .093 .173 .281	.172 .058 35 .167 .228 .256		
20	.038 .023 1259 .034 .058 .104	.078 .029 10 .066 .108 .124			
10	.023 .014 559 .020 .036 .054				
0	.023 .012 403 .022 .034 .058				
10	.029 .015 441 .027 .042 .069				
20	.033 .015 463 .031 .048 .067	.149 .090 5 .118 .183 .309	.257 .076 5 .249 .305 .371		
30	.043 .031 304 .034 .052 .169	.064 .044 106 .049 .096 .178	.098 .028 37 .094 .121 .152		
40	.027 .002 4 .025 .027 .030	.037 .008 8 .033 .047 .048			
50					
60					
70					
80					
90S					

TABLE C-3. - GASP OZONE DATA (PPMV) WITH RESPECT TO DISTANCE
FROM THE TROPOPAUSE DURING SUMMER.

Code:

Mean	St. Dev.	N
50%	847	98%

	more than 5000 ft below tropopause	0-5000 ft below tropopause	0-5000 ft above tropopause	5000-10000 ft above tropopause	more than 10000 ft above tropopause
LAT					
90N					
80				.491 .129 44 .551 .601 .640	.514 .104 21 .554 .619 .671
70	.030 .005 2 .025 .034 .034	.116 .081 83 .074 .196 .305	.372 .166 460 .378 .553 .657	.497 .135 617 .526 .630 .696	.535 .128 207 .547 .660 .730
60	.078 .041 185 .068 .096 .202	.134 .091 587 .102 .211 .398	.324 .142 1249 .317 .489 .599	.407 .127 767 .406 .529 .662	.442 .123 191 .450 .583 .641
50	.082 .051 1627 .073 .109 .247	.154 .117 1247 .108 .268 .482	.278 .128 863 .255 .409 .557	.356 .100 333 .374 .449 .531	.364 .099 42 .354 .429 .531
40	.067 .047 2537 .058 .088 .217	.137 .096 334 .104 .233 .407	.307 .137 47 .269 .484 .559	.207 .137 7 .139 .205 .531	
30	.053 .041 2037 .045 .069 .138	.089 .040 9 .106 .119 .138			
20	.029 .012 898 .028 .039 .060				
10	.024 .010 742 .023 .032 .048				
0	.024 .008 771 .023 .031 .043				
10	.031 .011 801 .029 .039 .061				
20	.052 .029 911 .045 .074 .132	.102 .065 35 .076 .143 .299	.306 .065 3 .346 .358 .358		
30	.049 .053 378 .060 .092 .209	.100 .059 435 .082 .151 .258	.181 .086 213 .158 .255 .434	.225 .091 30 .204 .292 .356	.395 .047 4 .363 .439 .443
40	.033 .010 2 .023 .042 .042	.229 .104 10 .158 .246 .380	.266 1		
50					
60					
70					
80					
90S					

TABLE C-4. - GASP OZONE DATA (PPMV) WITH RESPECT TO DISTANCE
FROM THE TROPOPAUSE DURING AUTUMN.

Code:

Mean	St. Dev.	N
50%	847	987

	more than 5000 ft below tropopause	0-5000 ft below tropopause	0-5000 ft above tropopause	5000-10000 ft above tropopause	more than 10000 ft above tropopause
90N				.400 .040 91 .402 .427 .476	.382 .035 25 .391 .410 .436
80			.265 .008 6 .264 .272 .273	.316 .064 47 .312 .335 .542	.489 .055 38 .478 .567 .582
70	.040 .009 2 .051 .068 .068	.127 .068 94 .103 .204 .283	.254 .081 412 .260 .336 .399	.342 .091 368 .346 .421 .548	.400 .104 116 .398 .493 .648
60	.062 .034 296 .054 .077 .201	.100 .058 948 .084 .159 .251	.220 .083 1159 .213 .309 .388	.296 .091 1044 .300 .387 .469	.379 .116 521 .379 .491 .635
50	.058 .038 1370 .051 .080 .172	.104 .061 1510 .091 .150 .306	.186 .082 1229 .169 .274 .383	.258 .112 599 .237 .366 .529	.383 .149 239 .378 .521 .681
40	.057 .032 1760 .051 .081 .137	.079 .038 607 .074 .114 .185	.162 .052 152 .154 .212 .321	.284 .097 31 .288 .379 .441	.422 .094 3 .422 .538 .538
30	.045 .025 1216 .043 .068 .103	.069 .032 10 .052 .093 .116	.160 .025 2 .135 .185 .185		
20	.044 .019 693 .031 .050 .044				
10	.030 .019 412 .024 .049 .083				
0	.033 .021 448 .028 .050 .087				
10S	.034 .026 624 .032 .066 .094				
20	.070 .045 657 .070 .104 .201	.154 .061 25 .149 .210 .303	.110 .032 5 .105 .105 .170		
30	.077 .034 278 .070 .109 .156	.117 .069 206 .098 .176 .326	.218 .122 88 .197 .379 .443	.292 .153 78 .293 .479 .536	
40	.095 .072 7 .083 .115 .251	.088 .084 107 .054 .136 .343	.170 .053 15 .164 .224 .255	.274 1	.422 .174 47 .359 .574 .774
50	.047 .025 15 .040 .055 .121	.093 .051 39 .083 .141 .229	.198 .071 51 .174 .285 .322	.356 .018 3 .368 .369 .369	.839 .105 67 .874 .901 .938
60	.019 .002 2 .017 .021 .021	.045 .027 12 .039 .055 .113	.310 .158 40 .397 .439 .467	.472 .092 67 .447 .584 .667	.728 .016 6 .723 .741 .746
70			.354 .061 100 .362 .416 .451	.400 .012 5 .404 .408 .414	
80			.294 .048 38 .279 .353 .369	.371 .048 82 .367 .407 .437	
90S					

APPENDIX D

AN EXAMPLE OF THE USE OF THE TABLES TO ESTIMATE THE FREQUENCY OF FLIGHTS ENCOUNTERING HIGH CABIN OZONE

This appendix describes an example of the use of the data tabulated in this report to investigate compliance with maximum and time-weighted average permissible cabin ozone concentrations established by Section 121.578 of the Federal Aviation Regulations (ref. 18). Wherever appropriate we have adopted the nomenclature used in reference 19. Anyone making this type of calculation for the purpose of demonstrating compliance should refer to ref. 19 and contact the FAA regarding acceptable data and procedures.

Problem:

How frequently would a B747-100, flying over the contiguous United States at medium altitudes (FL 335 to 385) in the spring, encounter ambient ozone levels sufficiently high to cause the cabin ozone limits in reference 18 to be exceeded?

Given:

Ambient ozone. - Mean, standard deviation, median, 84th percentual value, and 98th percentile value from table V (spring, FL 335 to 385).

Aircraft. - The retention ratio ($R = \text{cabin ozone}/\text{ambient ozone}$) for the B747-100 is assumed to be equal to 0.465 (refs. 13 and 20 to 22). Data from this airplane show that the average ratio of the density of cabin air to sea-level air at 25° C ($\approx P/P_0$) was 0.82. For flights over the contiguous U.S., the average time-at-cruise ($\approx T_{18}$) was 3 hr (see ref. 22, table IV). Allowing 1 hr for taxi + ascent + descent at zero ozone (ref. 18) gives an average flight segment time (T_{FS}) of 4 hr.

Ozone limits. - The rules in reference 18 require that, from takeoff to touchdown, the time-weighted average ozone level, $O3TWA$, in the cabin must be less than 0.1 ppmv ³SLE and that the maximum cabin ozone level, $O3MAX$, must never exceed 0.25 ppm ³SLE.

For the aircraft and flight parameters specified, these cabin ozone limits are equivalent to requiring that the average ambient ozone level at cruise be less than

³The statement of the rule in units of sea-level-equivalent ppmv (ppmv SLE) is equivalent to specifying limits on ozone density (e.g., g/m³). For a constant ozone density, the allowable true volume fraction (e.g., ppmv) in the cabin will vary inversely with cabin pressure (see appendix A and ref. 23).

$$\begin{aligned} & [\text{O3TWA limit}] \times (T_{FS}) / (T_{18}) / [(P/P_0) \times R] = \\ & [(0.1 \text{ ppmv SLE}) \times (4 \text{ hr})] / (3 \text{ hr}) / (0.82 \times 0.465) = 0.350 \text{ ppmv} \end{aligned}$$

and that the ambient ozone never exceed

$$\begin{aligned} & [\text{O3MAX limit}] / [(P/P_0) \times R] = \\ & (0.25 \text{ ppmv SLE}) / (0.82 \times 0.465) = 0.656 \text{ ppmv} \end{aligned}$$

Solutions:

Cruise mean limit. - It was shown in reference 22 that the probability of the cruise-mean level exceeding a given value can be approximated by the probability that any observation exceeds the same level. The solution given here will follow procedure I-A3 in reference 22, except that we will use the tabulated median, 84th percentile, and 98th percentile values as a four-point approximation to the cumulative frequency distribution (cfd). Since the data are tabulated by 10° latitude intervals, we will combine data from 30° to 40° N and 40° to 50° N at 75° to 120° W longitude as a reasonable geographical approximation of the contiguous United States.

The separate four-point cfd's for 30° to 40° N and 40° to 50° N are shown in part a of figure D1. Since the 84th percentile values are greater than 0.350 ppmv in both latitude zones, the probability of encountering ambient ozone above 0.350 ppmv will be greater than 16 percent. If necessary, we can obtain a numerical estimate as follows: for 30° to 40° N we find that the probability of encountering ambient ozone greater than 0.350 ppmv is 22.7 percent, and for 40° to 50° N the corresponding probability is 30.5 percent. Weighting these in proportion to the number of observations in each region gives a probability of 27.2 percent that the cruise-mean ambient ozone level will exceed 0.350 ppmv.

The composite cfd for 30° to 50° N calculated from the tabulated data is shown in figure D1(b). Also shown, to indicate the accuracy of the approximation, is the cfd for 30° to 50° N determined from original data. Because in most regions of interest, the cfd's will be concave upward, the approximation will, as seen here, tend to slightly overestimate the probabilities that would be determined from more detailed data.

If we examine the flight-averaged data for a B747-100 in domestic U.S. service from March 30 to June 13, 1977 (table IV in ref. 22), and delete flights to and from Hawaii, we find that 9 out of 40 flights, or 22.5 percent, encountered cruise mean ambient ozone levels above 0.350 ppmv. This is 5 percent less than our estimate, and indicates that calculations based on climatological data should not be expected to predict exactly the probability of encountering a given ozone level on individual flights or series of flights.

Maximum value limit. - The solution to this problem will follow procedure II-A3 in reference 22. In this example we first determine the probability that the ambient ozone level will exceed 0.656 ppmv on any observation. Since the 84th percentile values are less than 0.656 ppmv in both latitude zones, this probability will be less than 16 percent. Linearly interpolating between the 84th and 98th percentile values in the tables,

this probability is determined to be 3.6 percent for 30° to 40° N and 7.3 percent for 40° to 50° N. Weighting these based on the number of observations, the probability of encountering ambient ozone in excess of 0.656 ppmv on any independent observation is estimated to be 5.7 percent.

Following the procedure in reference 22, we assume that there will be two independent observations per hour at cruise, so for this example there will be six independent observations on the average duration flight. The probability of encountering one or more observations of ambient ozone greater than 0.656 ppmv is estimated to be (see ref. 22)

$$P(k \geq 1) = 100 (1 - (1 - (5.7/100))^6) = 29.7\%$$

Note that this is more than 22 percent greater than the probability of encountering ambient ozone above 0.656 ppmv on any observation in either latitude zone.

The estimate above may be compared with the flight-maximum values from the reference 22 example-case data set (again with Hawaii flights deleted) in which ambient ozone in excess of 0.656 ppmv was found on $13/40 = 32.5$ percent of the flights.

Other techniques which might be used to obtain the required estimates include procedures which use tabulated ozone mean and standard deviation values with an assumed form of the ambient ozone frequency distribution. This type of estimate is outlined in detail in procedures I-A4 and II-A4 of reference 22. Although the normal and log-normal approximations may give excellent estimates at some ozone levels, over the entire range of ozone encountered, the empirical method provides more reliable estimates than either method requiring an assumed frequency distribution. Therefore, the best approach is to use empirical probability data whenever they are available.

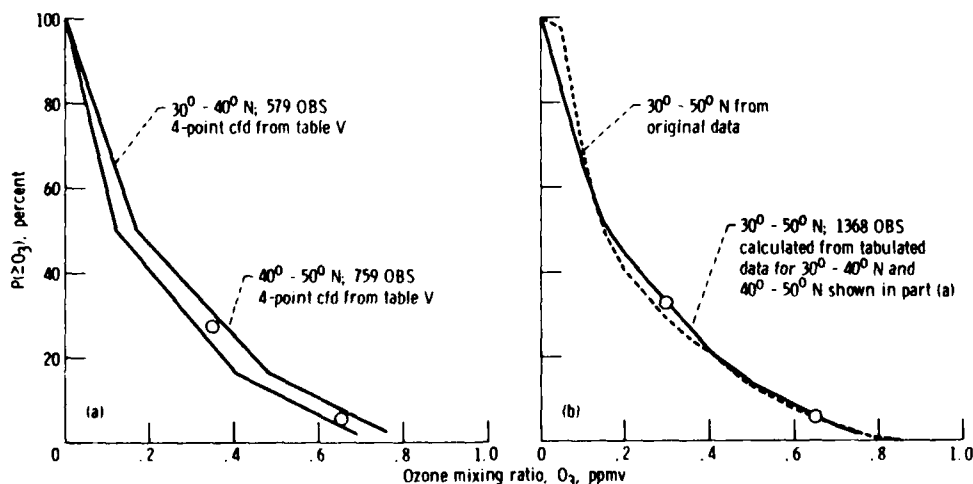


Figure D1. - Ozone cumulative frequency distributions for spring; 75° - 120° W longitude, flight levels 335 - 385. Symbols denote solution points in example-case calculation; see text.

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